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Education, Democratization, Political Stability, and Growth

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ABSTRACT

Short and Long Term Interactions Among Education, Democratization, Political Stability, and Growth

Walter W. McMahon

The main theme of this paper is that sustained growth and longer term political stability follow democratization, including the development of civic institutions and the rule of law. Democratization and the rule of law require widespread primary and secondary education that creates a large and economically viable middle class. The secondary theme is that these processes which are education externalities are slow and long delayed. Short term arms control measures and encouragement of some but not excessive expenditures on the military as a percent of each government's budget are also found to be helpful in sustaining democratization and longer run political stability. But it is possible that there is also at the same time some reverse causation; i.e., that democracies spend less on the military.

The analytical framework involves the dynamic interpretation of the economic growth and development process used in the new endogenous growth and endogenous development models in economics. In these, investment in expanding access to basic education has more modest initial impacts on the development of civic institutions, establishment of the rule of law, crime reduction, and economic growth. But each step simultaneously lays the foundation for future growth and development. The process then proceeds cumulatively, compounding over time. The non-economic (i.e. non-market) impacts of education are over and above the pure economic impacts on earnings or GDP per capita because they are generated by the human capital that the worker carries home and uses to increase his or her productivity in household production of final satisfactions both at home and in the community. The same dynamic cumulative process occurs within families over several generations. The entire process is slow, extending beyond the life span of any individual or even any dictator or elected official. This is a major reason inequality, authoritarian regimes, political instability, and civil wars persist throughout the developing world.

Education, Democratization, Political Stability, and Growth

Walter W. McMahon

This paper is largely based on Education and Development; Measuring the Social Benefits, McMahon (2002), which estimates the marginal short term and longer term impacts of increased education on the main economic growth and development goals. The market-measured impacts are on:

- Per capita economic growth, including earnings, and jobs,

and the non-market impacts on development are on:

- Better health, as reflected in lower infant mortality and increased longevity,
- Lower fertility and population growth rates,
- Democratization, or development of civic institutions, and the rule of law,
- Human rights, measured as civil liberties, also as in the Freedom House (2004) index,
- Political stability, as in the International Risk Guide Index (2004), and
- Reduced inequality, but only as each level of education is made universal.

Other non-market impacts of education that will not be discussed in the Globalization workshop on June 29 but that are discussed in this paper are:

- Environmental sustainability, measured as deforestation and wildlife destruction, water and air pollution, (education effects are indirect via poverty and fertility),
- Crime impacts; with lower violent crime rates and sometimes higher property crime rates as economic growth occurs,
- Larger investment rates in physical capital,
- Larger investment rates in education, a feedback effect from the growth process, and
- More technical change through education's contribution to R & D, but most important in the poor countries especially, education's contribution to innovation and to the dissemination of technologies and new knowledge about each of the above development goals. Education's net impacts on all of these development goals, including technical change, makes more specific and therefore replaces the dummy variable for "time" frequently inserted in growth equation regressions and alluded to

as representing “technical change” which remains unexplained.

Using a dynamic interpretation of the neoclassical model, such as in the endogenous growth (Lucas, 1998; Romer, 1990) and endogenous development (McMahon, 2004) models or earlier in Nelson and Phelps (1966), there are modest initial impacts from education but these then set the stage for future economic growth and development. These effects of education on development outcomes are education externalities and they are cumulative. This is important because the design of policies often do not take into account the long slow nature of these development processes. It is also important because externalities are the main rationale in economics for government intervention in markets in support of education.

This paper will focus on the dynamic processes involving education impacts on the development of civic institutions and democratization, human rights, political stability, and economic growth. It will present and discuss some of the regressions based on cross country data as well as some new insights about the nature of the dynamic process. But for greater technical detail, for consideration of the net impacts of education on the other development goals listed above, and for simulations which trace the net impact of policy changes under conditions that allow all of these development goals to interact, the reader is referred to McMahon (2002). This paper will also reflect the results of research by others on democratization and political stability.

The use of cross country data is important because it reveals impacts of education that choosing a data base within a single country cannot reveal. These include the potential effects of education on the development of civic institutions and political stability that feed back on and affect economic growth. These effects differ widely among countries, but do not vary widely among U.S. states or within any given country. Data on the extremely long time periods within a country that would be needed are generally not available.

There are major conceptual and measurement issues surrounding estimation of education externalities. The issues can lead to biases in the research for political reasons, given that externalities are a major rationale for government financial support. Consensus on

the magnitude, and even on the existence, of these externalities is open to question. Indeed the general estimation of education externalities has not been taken very far. So it is essential that these issues be addressed objectively, and some indication given as to how each measurement issue is handled. The conceptual framework for what it is that is to be measured must be considered, given that a dynamic perspective rather than a static perspective leads to different controls and different outcomes. It is also important to consider issues related to how to handle ‘innate ability and family factors’, offsets due to measurement error, imperfections in the quality of the data, impacts from factors unrelated to education, potential omitted variable bias, and the establishment of causality. These issues are all addressed in the book, and in the longer version of this paper (McMahon, 2003a).

Attention to these methodological issues in this paper largely will be confined to whether a basically static or dynamic view is taken of the nature of the dynamic process by which education contributes to development, the issue that the author regards as the most important. This distinction between choosing a static vs a dynamic view of the neoclassical model can be briefly summarized by comparing the original Solow (1956) model within which technology, the degree of democratization, political stability, and population growth are all taken as exogenous constants, to choosing dynamic endogenous growth models of Lucas (1988) and Romer (1990) that build upon and extend the Solow model. The dynamic view augments the Solow model with human capital formation and allows investment in human capital formation through education to affect the spread of technology and new knowledge in all fields, as well as other indirect effects in the endogenous development models (e.g., McMahon, 2002, 2004) that affect population growth, democratization, stability, and other development outcomes. Choosing this dynamic perspective has major implications for the specifications of the equations to be estimated, the definition of the variables, the type of data and the time frame to be examined, and the lag structure. These choices in turn have implications for the size of the education impacts and externalities that are found as well as for the capacity to infer causation from the underlying economic theory.

I. The Conceptual Framework for Education Impacts on Development

It is best to start with four conceptual distinctions. The first is between the market-measured impacts of human capital formation or education on earnings and economic growth, and the non-market impacts that generate private satisfactions and impact social development goals. The second distinction is between the direct impacts of education and indirect impacts. Indirect impacts of education are those that operate through another variable, such as education's impacts on democratization and stability as these affect growth. Another example is the impact of female education on health and fertility rates as these in turn affect per capita growth.

The third conceptual distinction is between private benefits to the individual and externalities, some of which are intra-family and some of which benefit the community and future generations. These lay the foundations for future growth and development, both within families and within nations. The fourth distinction is between the static or short-term immediate impacts, and longer term dynamic impacts which are delayed as all private and externality immediate impacts set the stage for future growth and development. The following considers each of these distinctions in relation to the existing literature as a foundation for interpreting the empirical estimates to be presented.

Market vs. Non-Market Impacts of Education

The market-measured economic growth impacts of education generated by the use of human capital during hours spent in the labor market raise the value of human time and productivity within firms. Standard social rates of return to education measure these, relating the discounted present value of increments to earnings to the full private and institutional costs when the full method is used. There is a recent survey of these worldwide by Psacharopoulos and Patrinos (2004, Table A-1) with summaries for each level of education and by region. It is important to recognize that the increments to earnings by education level reflect earnings over a medium term (e.g. a 43 year life cycle), in a partially static context, i.e. shifts in age-earnings profiles as each individual proceeds through his or her life cycle are not taken into account, as developed in Arias and McMahon (1998), and that earnings reflect education externalities within each family and within each nation including community effects

generated by prior generations such as effects from having functioning civic institutions or the lack thereof. In the aggregate economic growth in growth equations are market valuations of GDP per capita also reflect externalities, but are normally estimated using shorter term average annual impacts over 5 years, and not even the 43 year medium term increments of one life cycle. Cross-country data implies a much longer term, one in which governmental institutions can develop, civil wars subside, technical change disseminate, and population growth slow. On a simplified basis, looking across countries which reflects these kinds of long term dynamic changes, an additional year of schooling is associated with about 30% higher GDP per capita for example.

Non-market education outcomes include contributions to social development, but also contributions to private non-market satisfactions. The theoretical basis is that these are generated as each individual uses his or her human capital to the increase productivity and value of time spent at home or in the community. The marginal productivity of education within Becker's (1965) household production function can be augmented to include non-market intra-family and community-level externality benefits. That is, not only the Lucas (1988) market-based production function but also the Becker household production function are interpreted to include education externalities and their contribution to growth and to development outcomes.

To insure that the GDP per capita market-based benefits are not double counted, it is critical that estimates of net non-market benefits using a household production function first control for the market outcomes of education using per capita consumption or per capita income. The importance of doing this was stressed by Michael's survey of the literature (1982) long ago and continues to be stressed in the better surveys such as by Grossman and Kaestner (1997). The impact of education on better health, for example, is partially due the impact of education on income allowing the purchase of better health care, and partially due to the application of insights to better health during time spent at home and in the community. If a growth equation estimates the market impacts of education, and a household production function the non-market impacts, the market impacts of education will be double counted unless there is control for these in the estimates of the household production function.

To illustrate the four conceptual distinctions in a diagram that is also useful for showing the relation between indirect effects and externalities, the market returns to education are illustrated in Figure 1 as $A1 + B1$ (i.e. Row Y). The private and social non-market returns are shown as area $A2 + B2 + A3 + B3$ (Row Z-Y). If the non-market returns to education are each estimated after controlling for per capita income, (and for other non-education factors affecting each outcome), the result is the marginal non-market return to education that is additive over and above the market returns without overlap.

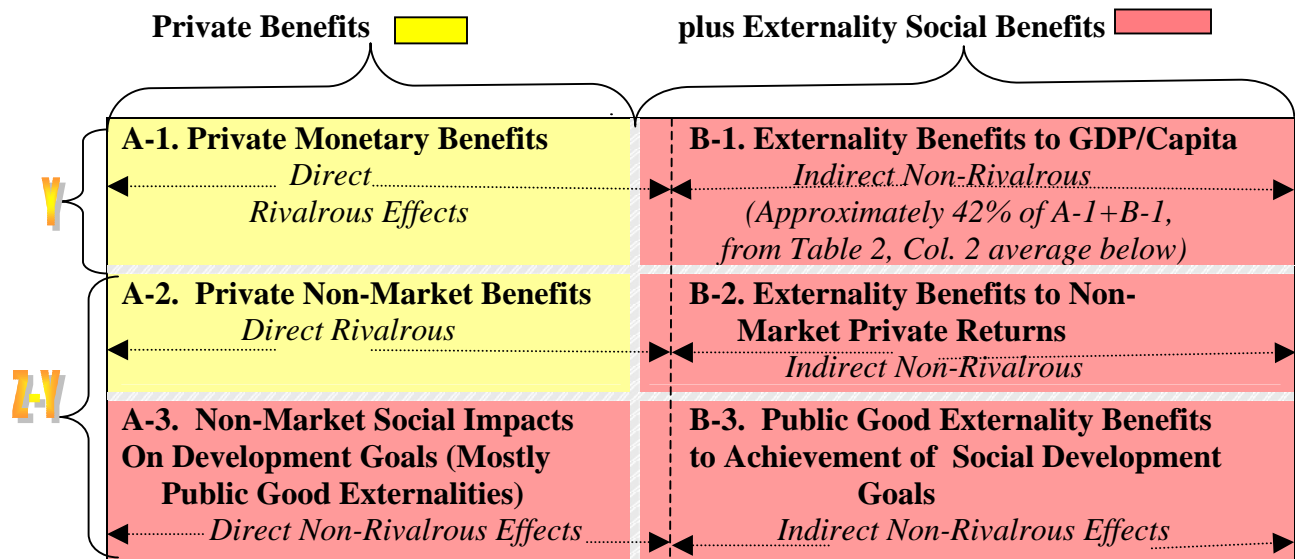
Direct vs. Indirect Effects of Education

The direct effects of education are those generating either market-measured returns or non-monetary satisfactions and development outcomes. They impact earnings and each non-market development outcome directly and within a reasonably short span of time, such as year or five year impacts. Because of this, and because of the controls, they are also the ‘static’ interpretation as implied by a ‘static’ interpretation of the neo-classical model. Direct effects can also be estimated over the medium term, as over a single life cycle, or even longer term over, say, 43+ years. It is the shorter term direct impacts based on a ‘static’ interpretation that are usually measured in growth equations, whereas estimates of the returns to education by the full method using the discounted present value of earnings over the of entire life cycle take a medium term perspective and reflect the impact on earnings of some indirect effects of education operating through other variables. The direct effects are illustrated in Figure 1 as areas $A1 + A2$, and to the extent that they exclude indirect effects are largely the same as the private benefits shown in the first column. There also can be some direct effects of education on each non-market development goal, although the shorter term immediate impacts are likely to be small since most of these are relatively slow processes.

Indirect effects are less obvious and need more discussion. To illustrate the problem, indirect effects of education include the effects of female education on reduced infant mortality and improved life expectancy, effects that then feed back and contribute to

economic growth as well as to other development outcomes. Yet it has been argued that life expectancy can and should be included as a control when estimating education externalities,

Figure 1. Total Net Benefits of Education



externalities that are largely the result of indirect effects. That is, life expectancy has been used as a proxy to remove the effect of technology, based on the argument that countries with advanced technologies boost their life expectancies (e.g., Heckman and Klenow, 1997, p. 15). This not only implies choice of a static interpretation of the neo-classical model, begging the question of the role of education in creating and disseminating these technologies, but it also removes the indirect effects of education on growth that occur due to longer life expectancy. It perhaps is not surprising that in this version of their regressions, education's contribution to growth was reduced to the extent that essentially no residual externalities were found. Similarly, if life expectancy is included in a growth equation, it reduces the contribution of female education to growth (Barro and Sala-I-Martin 1995, pp. 425-30). But more of this later.

A second example of indirect effects attributable to education is through the effect of education as it reduces fertility rates and hence, eventually, net population growth rates. Rapid population growth dilutes both physical and human capital in poor countries and contributes to slow growth. As education lowers fertility rates, there are fewer young dependent school-age children as a percent of the population. Given financial resources can be concentrated

more on each child, raising the quality of education in poor countries, and fostering human capital deepening rather than dilution. Slower population growth as an indirect effect of widespread basic education, abstracting from financial shocks, has contributed to more rapid longer term *per capita* growth in the Pacific Rim (World Bank, 1993, pp.31-5, 64, McMahon 1988b). A third and final example of an important indirect effect of education is its contribution to democratization and civic institutions by creation of a large and strong middle class (Dee 2003). This in turn contributes to greater political stability and through this to economic growth (See Barro 1991, Barro and Sala-I-Martin 1995, pp. 425-30, McMahon 2002, and Olivia and Riverera 2002).

Private Benefits vs. Externalities

Education externalities are spillover benefits or costs of human capital formation through the education of individuals to others in the community. They are not taken into account as the individual makes his or her private investment decision. This is because they are taken for granted by the individual and the family; the individual's investment is too small to affect the average level of education in the community (Lucas 1988), and the community effects of education are largely inherited from earlier generations so this is a given that cannot be significantly affected. Education externalities can be intra-family, although most discussed here are or community-level externalities, including the contributions to better civic institutions, democracy, stability, and social capital, or trust. Romer (1990) refers to most externalities as “non-rivalrous”, or benefits shared by all where the consumption by one does not significantly diminish use by others. These are traditionally referred to as “public goods” in the public finance literature.

There is an interesting relation between externalities and indirect effects. Virtually all indirect effects are externalities for the simple reason that most individuals and families do not see the indirect connections and therefore do not take them into account when investing (e.g. they see the direct impacts of education on a range of outcomes, but they do not take into account the secondary feedback effects from these on still other growth and development

outcomes). Furthermore most of these indirect effects are long delayed, sometimes affecting future generations. So they are not taken into account; the classic definition of an externality.

Although all indirect effects, which are somewhat easier to measure, are externalities, not all externalities are indirect effects. Some intra family and intra firm direct benefits of education are also externalities, so the direct benefits and the private benefits are not shown as exactly coinciding in Figure 1. The direct impacts of education on democratization, political stability, public health, creation and diffusion of technology, and slower population growth (in poor countries), however, are 100% externalities, not including additional indirect effects. These direct benefit-externalities from non-market development outcomes of education are illustrated by area A3 in Figure 1. It is assumed that these latter direct benefits are relatively small, since the processes involved are very slow and most operate with long lags. The bulk of education externalities are therefore indirect benefits, operating through one or more intervening variables, as illustrated by area B1 + B2 + B3 in Figure 1, which also will be shown later to be very long delayed.

This insight that most education externality benefits are indirect is important because the measurement of externalities heretofore has proved elusive and somewhat inconclusive, but indirect and delayed effects can be isolated and estimated.

Static vs. Longer Term Dynamic Effects From Education

The most important conceptual distinction, however, is probably that between shorter term impacts of education normally estimated using a static interpretation of the neo classical model, and longer term cumulative impacts based on a dynamic interpretation. A single life cycle is not long enough to include the impact of ancestors' and parents' education on the amount and quality of education received by the individual, or the benefits the individual enjoys from living in a developed community. (Alternatively, looking forward, there are spill-over externality benefits from an individual's education on the education of his or her own children and also from his or her impacts on the community throughout the life cycle.) Reflecting on this situation, Lucas (1988) assumes that the initial level of human capital that

each individual begins with is proportional to and typically greater than the level attained by older members of the family. He emphasizes “again and again” that “human capital accumulation is a social activity, involving groups of people, in a way that has no counterpart in the accumulation of physical capital” (Lucas, 1988, p. 19). The implications of this perspective are enormous. For one thing the production of human capital does not encounter diminishing returns. For another, this intergenerational effect combined with the embodiment of changing technology suggest that schooling inputs need to be measured in a way that includes embodiment of newer technologies through replacement investment in later vintages as persons retire (!). And for still another, it has been shown that this dynamic interpretation of the neoclassical model does not converge to constant per capita income in a steady state as does the Solow (1956) model in a ‘static’ interpretation without technical change and/or education externalities. Instead it contains the possibility of continuing per capita economic growth (and development) without bounds.

A Simplified Dynamic Framework. To clarify the dynamic nature of the development process, a simplified endogenous development model can be characterized by the three difference equations below. The growth equation, Eq. (1), is a simplified derivation from Lucas’ production function (1988, p. 18). His production function for market output is totally differentiated with respect to time and divided through by output to convert everything growth terms, and then population or labor force growth is subtracted from both sides to convert to per capita terms.

The development outcomes, D_i , are determined in Eq. (2). They are the non-market aspects of development, derived by applying a similar procedure to a Becker-type (1965) household production function. The latter must be augmented to include development externalities. Education is one influence on the attainment of each of these development goals, but not the only influence. Specifying other influences that are also significant, such as pure economic growth, y , and other aspects of development, D_j , the marginal productivity of increases in the value of human time due to education in these non-market activities can be estimated empirically.

The formation of human capital through schooling, s , is determined in Eq. (3). This human capital formation equation is again essentially from Lucas (1988, p. 19), and as indicated, it is dependent in part on prior education including the prior education of the parents. This equation, together with the others, also controls for all factors other than education that can be determined to be significant in affecting the outcome. Insignificant influences are collected in the three disturbance terms.

$$(1) \ y = \alpha_1 s_{-20} + \alpha_{i2} D_{i-10} + \alpha_3 \varepsilon_1$$

$$(2) \ D_i = \beta_{i1} s_{-20} + \beta_{i2} y_{-20} + \beta_{i3} D_{j-20} + \beta_{i4} \varepsilon_2, \ i \neq j$$

$$(3) \ s = \gamma_1 s_{-20} + \gamma_2 y_{-10} + \gamma_3 \varepsilon_3$$

Here:

y = Economic growth of real GDP per capita.,

s_{-20} = Education enrollment rates lagged 20 years. The lag is approximate, reflecting delays until each individual graduates and has time to learn enough of the job using his/her education to be productive. The lag also establishes the direction of causation.

D_{i-10} = Development outcomes, $i = 1, \dots, 14$ listed above lagged 10 years. This identification of

development externalities extends Lucas' (1988, p.11) "average level of human capital in the community", Becker's (1965) household production function in Eq.(2), and

potentially refines undefined "technology" represented by time dummies.

y_{-20} = growth of per capita GDP lagged 20 years. This lag represents time delays before most development institutions fully react in response to changes in GDP. This term also controls for education's market impacts on non-market outcomes. The lag in Eq.(3) shows causation in this equation to be from income growth to increased schooling.

$\varepsilon_1, \varepsilon_2, \varepsilon_3$ = Other factors significant in determining development and schooling outcomes.

For estimation, at least 5 year intervals must be used in the growth equation especially to gain independence from cyclical variation and short term erratic shocks. The length of all lags are not arbitrary. They are based on the logic of the process in each case as indicated above and discussed later. Empirical testing of alternative lags also is done before estimation

of the fully specified system in McMahon (2002). However the lags are simple. Complex time forms of lagged responses are avoided since they lose degrees of freedom, so each lag represents a distributed lag. Furthermore since D_i in Eq.(2) represents 14 development outcomes, each with different lags, the lag shown in Eq. (2) is a simplified approximation.

The resulting dynamic system can be solved recursively to generate 16 time paths. There is one for per capita economic growth, y , one for each of the 14 development outcomes, D_i , and one for schooling enrollments, s , which also grow endogenously. Each of these feed back on the other outcomes if their indirect effects are significant. Impacts within each period cumulatively affect the initial conditions for growth and development in the following period.

Static and Shorter Term Education Impacts. There are interesting things that can be seen by considering this simplified model, two of which will be mentioned.

First, focusing on development outcomes, if Eq. (2) is chosen and (1) and (3) are substituted into that, development outcomes become a function of economic growth but also of investment in education throughout the distant past. These development outcomes also grow and generally improve over time. As they affect per capita economic growth in Eq. (1) they can be interpreted as reflecting the impacts of technology and knowledge in all fields as education disseminates capacities to use and adapt it, as well as capacities to advance it. The D_i term in Eq. (1) seems conceptually superior to treating “technology” as an undefined black box and coping with it by introducing time dummy variables in the growth equation. The point is not that it is perfect; only that it is better than undefined time dummies. If the size of the coefficients of D_i in Eq. (3) are interpreted as reflecting the effects of education in embodying the new technology in all fields in each successive vintage of students via enrollments, then there is a mechanism for the capacity to use these new technologies and knowledge by which they can get into the workplace, the home, and the community and be effective. The rate of investment in Research & Development by firms and governments is also known to be relevant to growth in a small number of leading countries from work surveyed and done by Griliches (2000). But as far as the developing countries are concerned who cannot afford all of the failed experiments, it is the dissemination of the capacities to use

the results of this research, not all of which is in physical science and engineering fields, that is undoubtedly far more relevant.

Second, this simple dynamic structure can be used to distinguish between short term direct static impacts (one iteration) and longer term dynamic impacts (many iterations). The latter are always larger as shown by simulations over up to 40 years. They reflect the fact that education investment as measured by schooling enrollments exert an influence on per capita growth that is not instantaneous, but occurs repeatedly over an extended and perhaps infinite period of time. This same thing can be demonstrated in another way using the simple dynamic model above. The initial short run impacts of education on growth are measured by the first coefficient, α_1 , in Eq. (1) and are small. A *larger longer term coefficient* reflecting education's impacts over longer time periods can be seen to be produced since education impacts can be shown to occur with a distributed lag within this simple dynamic framework. If the development equation (2) is substituted into the growth equation (1), and then time is allowed to pass by lagging and re-using Eqs. (1) and (2) repeatedly, per capita growth becomes a function of past investments in education with a distributed lag. Of course growth many depend also on other variables, not all of which need have their impact on growth distributed.

If the resulting lags of education impacts are distributed geometrically, they can be represented simply as in Equation (4). This long term coefficient, (just as in Friedman's permanent income hypothesis), would normally be found when choosing longer time periods in the data:

$$(4) \alpha_1 \sum_{\delta=0}^{\infty} \lambda^{\delta} .$$

The long run parameter is clearly larger than the short run impact, α_1 , given that

the geometric distribution parameter must be positive, i.e., $1 > \lambda \geq 0$. This difference between short and longer term impacts of education on growth is demonstrated empirically by Topel (1999, Table 4, p. 2969), although he does derive it analytically.

With a dynamic interpretation, each immediate impact of education obtained using a 'static' interpretation of the neo classical model clearly sets the stage for future growth. As

this process continues within each successive time period, the total impacts of a given level of education investment on development outcomes cumulate, improving each.

Summing up the conclusions for use in interpreting the research in the literature:

- ***Immediate impacts of investment in education on growth and development are small or zero.*** Specifically $\partial y / \partial s = 0$ in Eq.(1) and $\partial D_i / \partial \partial s = 0$ in Eq. (2).
- ***Short term static impacts are usually found to be positive but small.*** Studies that are limited to a single life cycle and control for SES exclude education impacts over two or more generations in effect ignore Eq. (3) and the passage of time. Those that control for “community effects” and time preclude influence from D_i . This excludes education’s indirect effects and hence most externalities. A static interpretation treating technical change as a constant may be roughly equivalent to this. The short term direct effects are $\partial y / \partial s_{-20} = \alpha_1$ in Eq. (1) and $\partial D_i / \partial s_{-20} = \beta_{i1}$ in Eq. (2).
- ***Short term total impacts that include indirect effects, and are larger. This can be shown by substituting Eq. (2) into Eq. (1) and estimating the resulting reduced form. The resulting coefficient of s_{-20} is $\partial y / \partial s_{-20} = \alpha_1 + \alpha_2 \beta_{i1}$ that is larger than α_1 .***
- ***Longer term dynamic effects are still larger.*** Using a dynamic interpretation development outcomes grow. Then longer term effects of schooling investment operating through these development variables are larger. For example, when the model is solved recursively generating time paths for per capita GDP into the future, education impacts continually set the stage for future growth in each succeeding period.

This process can be explained in another way. First, it is not just the schooling coefficients α_1 , β_2 , and γ_1 in the model that measure education’s impact, but also:

- ***Education enrollments, s , grow as\ a function of earlier investments in education, Eq. (3), as well as the short-term coefficient α_1 , choosing longer time spans.***
- ***Physical capital investment rates in most growth equations, I_K/Y , grow. They are one development outcome affected by past education and by political stability.***
- ***Other development indicators, D_i , also grow, which are a function of past education investment [Eq. (2)]. These include technology and its diffusion.***
- ***New technology is also diffused through replacement investment in human capital as the skills of persons who retire or die are replaced and improved.***

II. Empirical Estimates of Education Externalities

The *value* of education's impacts on development outcomes are normally not measured directly, but instead as a percent of the market effects of education on GDP per capita.

Empirical Estimates via Static vs. Dynamic Interpretations

The dramatic difference in the size empirically of the effects of education externalities obtained in the economics literature of using the narrower interpretation is shown by comparing the results of studies which use a static and short term interpretation with the results of studies which use a dynamic and longer term view. The latter are summarized in Sections I and IV of Table 1 and the former in Sections II and III.

Using a dynamic interpretation of the neoclassical model that allows the impacts of technical change to occur, Heckman and Klenow (1997, p. 14) and Topel (1999, p. 2965-6) in separate studies estimate the social rate of return to be about 30% and 23% respectively from cross country data as shown in Section I. They estimate the social return or externality component by using cross country GDP per capita regressions and then subtracting the private returns to schooling based on individual earnings data in Mincer regressions. To get a rough idea of potential differences among regions, Topel's estimate of 23% is used and shown in Col. 1 from his cross country regressions using the Summers-Heston and Barro-Lee data. From this is subtracted the private rates of return of 7-9% depending on the region based on micro earnings data using the Mincer method from Psacharopoulos and Patrinos (2002). The externality component is thus estimated to be about 15.7% in Africa, 14.8 % in Latin America, 14.2% in Asia, and 14% in OECD countries as shown in Table 1, Section I, Col. 1. This is the same method used by Topel and by Heckman and Klenow except that their 23% social rate does not vary among regions. The externality component averages 14.67% which is 63% of the social rate of return. In this approximation, the larger externalities occur in the poorest and most unstable nations. This same pattern reappears in Section IV of Table I based on entirely different methods.

Section II uses a narrower static interpretation of the neoclassical model. It controls for differences in technology by one means or another, and most of these externalities largely disappear. When Topel (1999, p.2965) controls for technology by using time dummies, his social rates are in the 7.2%-8.5%-10.2% range. So after subtracting the average 8.3% private returns, externalities are essentially wiped out. The problem with this use of time dummies, as well as with use of life expectancy as controls is that both are development outcomes that are functions of education as suggested above. So although the first regression interpreted as allowing for dynamic effects uses no controls for factors other than education and therefore probably overestimates the value of externalities as 68% of the total, the second set of regressions underestimates externalities at 0% by including regressors that preclude almost all indirect effects.

Heckman and Klenow's (1997, Table 2) social rates that average of 30% (Section 1 below) are lowered to 10.6% in 1985 and 7% in 1960 when life expectancy is included. They interpret life expectancy as reflecting medical technologies, and hence a control for technology. After the average private rate of return of 8.3% is subtracted, this leaves only 2.3% in 1985 and 0% in 1969 for externalities (Section II).. But again the inclusion of life expectancy as well as vaguely defined 'technology' are highly problematical. As they recognize, "life expectancy itself is endogenous and may be a consequence of schooling attainment, directly through information and indirectly by generating more income" (ibid. p. 15). Life expectancy (and technology) are development indicators in Eq. (2) above that feed into the growth equation. So although the social rate of return at 30% and hence externalities are likely overestimated when there are no controls for factors other than education, they are underestimated when a static view is taken and education's indirect effects through life expectancy and technology are excluded.

In the remainder of Section II, Benhabib and Spiegel (1994) and Prichett (1997) take only the static or shorter term view. They remove most human capital externality effects on per capita income or growth by using controls for political instability and inequality. Based on this narrower interpretation, and using average educational attainment which does not allow

for the impacts of technology through replacement investment as successive age cohorts receive their

Table 1
Estimates of the Overall Value of Education Externalities in Economic Growth

Externality Rate	Basis for Estimate	Source
I. Market-Measured Social Returns Only Using a Dynamic Interpretation:		
AFRICA: 23%-7.3%= 15.7%	The schooling coefficient from a cross-country growth equation determining GDP/Cap less private returns obtained using individual Mincer regressions. Topel is the 23%; Heckman & Klenow: 30%	Heckman and Klenow (1997), and Topel (1999).The breakdowns of externalities by region are estimated by the author by subtracting private rates of return from Psacharopoulos and Patrinos (2002) by region.
LAC: 23%-8.2%= 14.8%		
ASIA: 23%-8.8%= 14.2%		
OECD: 23%-9.0%= 14.0%		
II. Removing Education’s Role in Disseminating Technology, Using a Static Interpretation		
8.4%-8.3% ≅ 0%	Cross-Country Coefficient as above with controls for “technology” using time dummies and/or life expectancy	8.4%=Average of Heckman and Klenow (1996:10.6%) & Topel (1999:6.2%) less 8.3% Pvt. Rate
0% 0%	Human capital measure used is Av. Ed. attainment which excludes technology effects of replacement investment. Also controls for political instability and inequality remove other education externalities.	Benhabib and Spiegel (1994) Prichett (1997) (Benhabib and Spiegel (1994) stress but do not include the effects of education in raising physical capital investment, an externality)
III. Intra-Country Externalities, Shorter Term, Inter-Country Development Impacts Excluded		
Primary 17%	Differences among SMSA’s; Wage is higher if average education level is higher by .03 Av. Ed/.048 Indiv. Ed	Rauch (1993: 389 ,399): 68% of the market rate
Secondary 11%		
Higher 12%	Exponents based on US data 1909-57	Lucas (1988): 60% of the mkt. rate
US Higher Ed. only: 11.0%	Earnings differences among cities	Moretti (2002: 24) (i.e. 25-14%)
0%	Compulsory attendance laws used as debatable IV instruments for average schooling. Narrow aspect (only sec. education) of externalities measured.	Acemoglu and Angrist (2000). Inter-state within United States. See Rouse’s (2000) comments on narrowness of what is measured
7%	Increase in TFP, 4 mil individuals, 163 US cities ’70-90. Regional dummies remove most externality effects.	Ciccone and Peri (2002: 38). The 7% is .085 (Δ Average Schooling)
IV. Education Externalities Using Inter-Country Data, Including Dynamic and Indirect Effects		
AFRICA AVERAGE 17% (45% of Market Return)	Indirect effects are externalities that feed back on GDP. Cross country data used to estimate net education effects on democratization, civic institutions, political stability, and physical capital investment. Lower Pop. growth &	McMahon (2002: 236); Appiah & McMahon (2002: 55)
LAC (Brazil): 6% (41% of Market Return)		McMahon (2002: 232, 234, & 240)
ASIA (India): 5% (39% of Market Return)		Note that Africa’s externality rate

OECD: (US): 4% (37% of Market Return)	higher economic growth also raise per capita investment in education.	(17%) is close to Topel's (1999) & Heckman & Klenow's (1997) but other regions are lower.
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formal education, they wind up with no externalities. Benhabib and Spiegel do discuss the evidence of impacts of education on the rate of investment in physical capital. But these impacts are not included in their empirical estimates of education externalities. As in some other studies that use the average years of schooling as a measure of past investment in human capital, they find little or no human capital effects. Differentiation of the Lucas (1988) model with respect to time calls for the rate of investment in education, which must be measured either by enrollments or by expenditures on education, to be related to growth of per capita GDP. Krueger and Lindahl (2001: 1130) conclude that the *change in* education is positively associated with growth after measurement error in education is accounted for. However replacement investment embodying new technologies is well over 90% of total investment in education in most countries. The Benhabib and Spiegel (1994) and Prichitt (1997) measures do not take either into account. They also use controls that eliminate indirect effects of education, and so can be interpreted as implicitly taking the static view. This eliminates most externalities and impacts from development outcomes as has been shown.

Implications of the Quality and Types of Data Used

This is an appropriate point in this review and presentation of new estimates of education impacts on development goals to address issues that have arisen in the literature about the quality of the data. Rather than reject studies out of hand, it is better to try to appraise the direction and size of the potential biases that the choice of data introduces. Judgments must be made since no data is perfect, and since choice of the type of data used must be made considering what is appropriate to the research question addressed.

Enrollment Rates vs. Attainment as Measures of Education Investment. With respect to studying education impacts on growth and development, an initial choice must be made between a focus on levels (GDP per capita) or on rates of change (growth). If cross country data is used, the advantage in focusing on growth is that the relevant variables are

ratios such as growth rates, rates of investment in physical and in human capital, and education enrollment rates. These are pure numbers largely independent of the distortions introduced when converting levels using exchange rates and cross country inflation rates. The alternative when focus on levels is to use the adjusted data developed in Summers' and Heston's Penn World Tables (1991) and on educational attainment by Barro and Lee (1993) as is done by Topel (1999) and Heckman and Klenow (1997) among others.

The major drawback of focusing on levels and using average educational attainment is that it fails to reflect the embodiment of technical change that occurs through replacement investment in each new student cohort which is important as mentioned above. This fact alone largely precludes a truly dynamic view of the human capital formation process since new technologies are largely embodied by replacement investment. Furthermore, if 100% of all education investment over a period of time in some country were replacement investment, the net contribution of average educational attainment over that time would show up as zero. This omission of the role of replacement investment is consistent with a static view that treats technology as a given. But it then underestimates the contribution of education.

Focusing instead on growth encourages use of changes in the stocks of human capital as measured by enrollment rates, or by expenditure on education as a percent of GDP to measure education investment. This focus on changes is implied by the Lucas (1988, p. 18) production function after taking the logs and totally differentiating it with respect to time. On the other hand, if education enters the underlying production function exponentially, or if as in Romer (1990) the existing *stock* of human capital improves the country's R&D capacities and capacity to innovate, then using levels may be more appropriate. But his greater emphasis on the relevance of education to R & D may be more important in the leading R&D countries, and less important for the diffusion of knowledge within developing countries. Even in the leading countries, each new graduating class, especially of PhD's at research universities, is a very major means of diffusing the newer technologies and the knowledge of how to use them.

A second advantage of using enrollment rates is that data is available for separate primary, secondary, and higher education enrollment rates which allows separate marginal products, and hence separate rates of return to each, to be computed. This gets away from the assumption of linearity in the returns to each additional year of education which has been seriously criticized (Krueger and Lindahl, 2001, pp. 1129-30). It is well known that the rates of return to primary, secondary, and higher education differ (see the studies summarized in Psacharopoulos and Patrinos, 2002). Of course rates of return to any given level of education vary among countries depending heavily on whether most in the labor force already have that level of education. But this can be minimized by estimating education impacts by country or by regional groupings, as has been done at least for the growth equation in McMahon's (2002) model for which simulations are to be presented.

But using gross enrollment rates also is not without its drawbacks. Behrman and Rosenzweig (1994, p. 150) report that school gross *enrollment rates* based on government statistics as reported by UNESCO overstate average *attendance rates* by an average 10% based on household surveys. This pattern of difference between opening fall enrollments and average daily attendance is well known, and is the basis for the typical recommendation that school funding be based on average daily attendance rather than on enrollments (McMahon, Suwaryani, and Boediono, 2002, for example). This overstatement is likely to be larger in the poorer countries since drop out rates are higher. Kingdon and Muzammil (2003) cite serious overstatement of enrollment rates in India, for example. It is also well known that gross enrollment rates include overage and underage children (e.g. Behrman and Rosenzweig, 1994, p. 150-1). This is another inefficiency that tends to diminish as the education system matures and quality improves. Yet gross enrollment rates are logically more appropriate to the analysis of outcomes than net enrollment rates since school budgets must provide for overage and underage children and this is part of the true investment in education that is being made.

Allowing for some overstatement in gross enrollment rates in the UNESCO data that is likely to be larger in the poorer countries, the nature of this measurement error is such that it

will contribute to *understatement* of the returns to education. This is relevant to the further analysis below of the size of all potential net biases in the estimates of education impacts.

“Ability” and Unobserved Family Factors. There is a potential *overstatement* of the size of the impacts of education on development outcomes due to the omission of unobserved ‘innate ability’ and family personality factors. But there is also potential understatement of these returns due to measurement error in the education variable in addition to that mentioned, including self-reporting bias and the partial omission of the quality of the education.

With respect to the scope of the additional measurement error in cross-country data, general overstatement of enrollments due to self-reporting by governments to UNESCO of these enrollment rates does occur. It is similar to the measurement error of education levels by individuals in household surveys which is also due to self-reporting. The greater tendency of enrollments to overstate actual investment in the poorer countries where drop out rates are also higher is similar to the overstatement of schooling attainment by those individuals who have less education. This has been extensively studied, with the usual conclusion that the *downward* bias in estimates of the returns to education due to measurement error is approximately offset by the upward bias due to unobserved innate ability and family factors (Griliches 2000, and Card 1999). It seems reasonable to assume that in the absence of evidence to the contrary the measurement error in the enrollment data that is self reported by governments to UNESCO also partially offsets the bias due to unmeasured ‘innate ability and family factors’. But the size of the offset is still largely unknown.

However it is known that the ‘ability’ bias to be offset is relatively small, — probably much smaller than is commonly believed. To consider this, in recent studies of large samples of identical twins Ashenfelter and Rouse (1998), Behrman and Rosenzweig (1999), and Rouse (1999) are able to remove the effects on education outcomes due to unmeasured ‘innate ability and family factors’ under highly controlled conditions. They find that unobserved ‘innate ability and family factors’ account for about 31% of the net returns. But they note that ‘family factors’ are partially due to the education of the parents and the grandparents. That is, their

31% includes part of the contribution from education to development when a longer term dynamic interpretation of education as a multi-generational social process is chosen. This implies that ‘innate ability and family factors’ account for something *less* than 31%. There is no reason to think that this would be much higher or lower in international data. So this sets an upper bound for any potential overestimate of the returns to education due to ‘ability’ bias.

But these same studies also find that measurement error due to self-reporting of education levels by individuals and due to the omission of the effects of educational quality *raises* the corrected return to education by about 28%. Given the wide variation in educational quality internationally, the measurement and quality biases in international data are likely to total more than, not less than, 28%. These two effects, — something under 31% minus 28% or more, are almost exactly offsetting. No strong assumption is made here that the biases in international cross-country data due to unmeasured ‘ability and family factors’ and to measurement error in self-reported enrollments or attainment are identical to these sources of bias in individual data. However the direction and the nature of potential biases are apparent. And the (reasonable) judgment can be made that the net effect of these biases is drastically less than 31%. It is a judgment call, but if these sources of bias in the international data operate in the directions mentioned and are of roughly the same order of magnitude, they operate toward netting themselves out. Then as Griliches (2000, p. 38-40) observes based on his lifetime of studies as well as on work by others, the OLS estimates uncorrected for unmeasured “ability and family factors’, offsetting measurement error are not seriously misleading.

The Quality of Education.. Quality is well known to contribute to individual earnings in both advanced and in developing countries. Behrman, Ross, and Sabot (2002) recently find in a close comparison that it contributes almost, but not quite, as much as expansion of access in Pakistan. The significance of quality is supported in other empirical studies as well such as Behrman and Rosenweig (1994, p. 152), Behrman and Birdsall (1983), Hanushek et. al (1992), and Card and Krueger (1992).

The partial omission of quality is likely to be another source of the insignificance of

education in Benhabib and Spiegel's (1994) and Prichett's (1997) results reviewed above. They use average educational attainment that neither includes the quality of education nor the embodiment of capacities to use newer technologies through replacement investment. Both average educational attainment and enrollment rates, however, although they primarily measure quantity they also partially reflect quality. This is especially true in developing countries where the quality is often low. In order to achieve higher enrollment rates it is almost essential that the quality be adequate; otherwise parents will not send their children. When better quality education is extended to children from poor families, enrollment and attendance and attainment rates are often observed to increase, as is found in Brazil by Behrman and Birdsall (1983) and Indonesia by McMahon, Suwaryani, and Boediono (2002). So given that comparable measures of quality across countries do not exist, it is important to recognize that this omission of quality is a source of measurement error, but because minimal quality is partially reflected in attainment and enrollment rates, the omitted variable bias to the estimates of education's impacts are likely to be smaller.

Intra-Country versus Cross-Country Data. Additional empirical studies of externalities summarized in Section III, Table 1 are limited to differences among states or provinces within the same country, e.g., Acemoglu and Angrist (2000). This choice of data appears to average out the larger impacts of education that show up in differences among cities as found by Rauch (1993) and Moretti (2002). All of these intra-country studies also omit indirect education impacts operating through education's contribution to civic institutions and political stability which do not vary as much within a more homogeneous single nation data base. These indirect effects show up in cross-country data in Barro (1991, 1997) and in McMahon (2002). In spite of the use of US inter-state data, Acemoglu and Angrist (2001) find a 7% private return to schooling, slightly lower than what most researchers estimate, and education externalities based on OLS of 7.3% which are roughly the same order of magnitude of the private returns. This estimate puts externalities at 51% of the total market returns. It is only when they introduce their instrumental variables of change in compulsory attendance laws and in child labor laws by states that the education externalities largely disappear. It is a clever procedure of trying to get around presumed self-selection 'ability' bias due to the migration of more "able" individuals to the states that have higher average education levels. But the offset from measurement error is not considered, and

validity of the results depends on the quality of the instruments. Questions have been raised about the use of these instruments by Rouse (2001) and others. She notes that these laws are negatively correlated with college attendance rates! So use of these laws as instruments wipes out all externalities from college attendance, a point also stressed by Blanchard and Mankiw (op.cit, p. 73).

The most important point, however, made by Rouse (2001, p.71) and Bils (2001, p.65) is that the approach followed by Acemoglu and Angrist (2001) captures a relatively narrow form of externality. It addresses externalities due to secondary education only, leaving out primary and higher education externalities. It also leaves out education's "effects on tax revenues, government transfers, and criminal activity" (Rouse, p. 71), omits "benefits (to) a future spouse", effects on voting behavior, and omits effects on "lower crime from keeping young men in a monitored setting" (Bils, p.65). It also leaves out the effects of education on investment rates in physical capital. Furthermore it captures only the static immediate effects and leaves out dynamic effects (Venniker, 2001). The dynamic and indirect effects include effects from new technology embodied via replacement investment in human capital, the intergenerational transmission of education benefits, and education externalities through improved civic institutions and political stability.

Ciccone and Peri (2002) also in Section III of Table 1 base their work on differences among United States cities. But they use regional dummies as "controls". These dummies remove most longer term indirect effects of education through indicators of development such as those included in D_i in the simple dynamic model presented above. Their estimate of 7% externalities is below that obtained by Rauch (1993), probably because of this procedure. It is also slightly below Moretti's (2002) 11%, although the latter relates only to higher education. Rauch's (1993) estimate in Section III of Table 1 finds total education externalities to be 68% of the market social rate of return. This is close to Lucas (1988) who estimates externalities by other methods to be 60% of the market social rate. Multiplying the mean of these by the rates of return at each education level given by Psacharopoulos and Patrinos (2002) gives an estimate of those education externalities that are market-measured in the US of 17% at the

primary level, 11% at the secondary level and 12% at the higher education level shown in Section III, Table 1. The latter estimate for higher education externalities derived from Rauch (1993) and Lucas (1998) of 12% is close to Moretti's (2002) estimate of 11%.

Potential Error Margins Overall. The data quality is such that none of the available measures of education inputs or of development outcomes are perfect. But each have different error margins. Littanies of the many problems, the most serious of which have been addressed here, can be found in Behrman and Rosenzweig (1994) and Lloyd and Hewett (2003). Average educational attainment, enrollment rates, attendance rates, expenditure on education as a percent of GDP, school completion rates, literacy — all have their flaws. The data on development outcomes such as life expectancy, inequality, democratization, poverty, human rights, and homicide rates also are not perfect. The problems with the health statistics and labor force indicators for example are discussed by Srinivassan (1994). But still much can be learned, allowing for reasonable error margins. The data on water and air pollution are very sketchy, and the resulting estimates of education impacts have probably the widest error margins. The international crime statistics from INTERPOL on property crimes other than homicide appears to notoriously bad due to under-reporting. But all social scientific research is subject to error margins; there is never precise deterministic precision. The estimation of education externalities is no exception. Instead it is better to make thoughtful judgments, and qualify the conclusions in accord with the judgments about potential biases in the estimates and related error margins.

The Overall Size of Education Externalities; A Summary

It is purely a judgment call. But considering the above measurement issues, and including simultaneity and controls for impacts other than education on development outcomes addressed further below, the main sources of potential bias operate in opposite directions and appear to approximately cancel out, or even lead to modest underestimates of the size of education's impacts. An exception must be made for the estimates of the indirect impacts on water pollution, air pollution, and property crime since the data for these specific development outcomes is the worst and the error margins therefore the largest. But allowing

for this, the source of the largest variation in the size of the estimates is likely to be due to whether a static view of the neoclassical model is chosen, or instead a dynamic specification is used allows for the size of the indirect effects from education to be included. Taking the latter view, the size of the impacts of education then appear to be affected most heavily by the length of the time period chosen over which the distributed lag of education impacts operates.

Empirically using a dynamic interpretation, externalities via education impacts on development outcomes appear to average less than 68% but something more than 37% of the market returns to education. These are summarized in Table 2 below in Columns 1 and 2 respectively. The *non-market private* returns are estimated in this paper to have a value of about 80% of these same market returns as developed in detail in the Appendix. If it can be assumed that for these non-market private returns, the direct and indirect effects stand in about the same ratio as they do for market returns, then 68% is the upper and 37% the lower bound for the total value of education's impacts on all market and non-market development goals.

These estimates are based on cross country data as was shown in Sections I and IV of Table 1. Heckman and Klenow's (1997) and Topel's (1999) estimates are in the 68 to 61% range, and McMahon's (2002) and McMahon and Appiah's (2002) are in the 45 to 37% range depending on the region. These should not be misread however as 37% to 68% social rates of return! To convert them to the externalities contained in standard social rates of return, they must be multiplied by the social rates of return reported by Psacharopoulos and Patrinos (2002: Table 1). Then the rate of return to investment in education for achieving development goals is 15.7% to 17% in the poorer regions such as Sub-Saharan Africa. This pure externality component in the middle and higher income regions is somewhat smaller, or 14.8% in Latin America and only 4% in the OECD countries. (The externality component in higher education alone in the US however works out to 5.9% based on Moretti's (2002) estimates, partially because standard social rates of return to higher education in the US are higher). The reason for this pattern is likely to be that there are higher social returns to primary and secondary education in the poorer countries, including those from slower population growth and greater political stability. Given that basic education is not universal there the simulation model in Column 2 directs relatively larger fractions of new education investment to these levels.

Table 2
Education Externalities as a Percent of the Total Returns to Education

Region	Value of Development Outcomes as a Percent of Total Returns to Education	
	Upper Bound Computed from Heckman and Klenow (1997) and Topel (1999) (1)	Lower Bound McMahon (2002) and Appiah and McMahon (2002) (2)
Africa	68%	45%
Latin America	64%	41%
Asia	62%	39%
OECD	61%	37%

* Source: explanation in the text. These are *not* rates of return!

The valuation of externalities at 61-68% of total returns to education in Column 1 is almost surely an overestimate because it does not control for factors other than education that affect growth and development. These percentages therefore are taken to be an upper bound. But beyond this, Heckman and Klenow's (1997) and Topel's (1999) estimates are larger for the reason that their implicit time period is longer than the 40 years in McMahon's (2002) simulations. The estimates in Column 2 underestimate education impacts and hence externalities partially because measurement error in the quantity and quality of education overcompensates for "ability" bias. They are therefore suggested as a 'lower bound'. Whether Column 2 is instead an overestimate of education externalities due to omitted variable bias is also a legitimate question. It does not seem very likely because there are over 54 variables used as controls in the model, different ones in different equations. This is not to speak of the many things affecting outcomes that are thought to be important by some but were not found to be statistically significant. Perhaps others can find additional things other than education affecting these development outcomes. So this matter of and remaining potential 'omitted variable bias' will have to be left to the reader to judge as he/she reads through the brief

description of impacts on development outcomes that follows, and refers to the specific estimates and alternative specifications discussed in detail in the book (McMahon 2002). This aside, the estimates from the model are smaller not just because of all of the controls that were in fact used, but also because the simulations only run for 40 years, and not for the long time periods implicit in Topel, Heckman, and Klenow. Most of the education impacts do not fully converge to either a stationary or a steady state within a 40 year time span (McMahon, 2002).

III. Education's Effects on Separate Development Goals

It is useful to present a more specific taxonomy of education effects on specific development goals. These externalities also are indirect effects that feed back on economic growth (market) and non-market private satisfactions included in the overall estimates in Table 2. The specific estimates of education impacts after 40 years on each of these development goals are summarized later in Table 3.

Which Effects Are Pure Education Externalities?

The direct effects of education on development goals listed in Category II in the taxonomy below are pure externalities. This is true by definition since each of these development goals are non-rivalrous goods in Romer's (1990) terms whose benefits are shared indivisibly by all. They include the benefits of democracy, human rights, political stability, lower crime rates (netting out the negative externalities for white collar criminals), and a cleaner environment. Many of these effects are long delayed and affect future generations.

All indirect effects are also pure externalities. They feed back either on economic growth (Category I in the taxonomy), on non-market private returns (Table 4, in the Appendix), and on development goals (Category II). All indirect effects of education have one thing in common, — they operate through an intervening variable. Just as with the direct effects on development goals, they are externalities because any given individual cannot affect their community wide average and does not take them into account when making his or her private investment decisions. (They were summarized in Figure 1 as areas B-1 + B-2 + B-3).

Impacts on Development Goals From Investment in Education

I. Education Effects on Per Capita Growth (indirect effects are externalities):

- 1.1 Direct effects of education on per capita GDP and growth**
- 1.2 Indirect as education increases physical capital investment through political stability**
- 1.3 Indirect as growth increases education investment**
- 1.4 Indirect as education disseminates technology and new knowledge in all fields.**
- 1.5 Indirect as improvements in all development goals below affect growth (Lucas' h_a^y)**

II. Education's Non-Market Effects on Development Goals (pure externalities):

Population and Health Effects (Controlling for Income)

- 2. Better Public Health**
- 3. Lower Net Population Growth Rates**

Strengthening Civic Institutions and the Rule of Law (Controlling for Income)

- 4. Democratization: Authoritarian regimes accompany illiteracy**
- 5. Human Rights: a function of democratization and of education**
- 6. Political Stability: aided by better civic institutions (democratization)**

Lower Crime Rates (Controlling for income)

- 7.1 Lower Homicide Rates, Lower Property Crime Rates**
- 7.2 Less Policing, Incarceration, Court System, and Private Security Costs**

Indirect Environmental Effects (Controlling for Income)

- 8. Less Deforestation (for cooking, less dependence on timber exports)**
- 9. Less Water Pollution: as education slows population growth**
- 10. More Air Pollution (a negative externality due to induced growth)**

Community Service Effects of Education (Controlling for Income)

- 11. More Gifts of Time and Money to Community (At each given income level)**
- 12. Knowledge Dissemination: articles, television, internet, and informally**

Poverty Reduction (Controlling for per capita income, which is a private benefit)

- 13. Urban Poverty Reduction; e. g. education's effect via smaller families**
- 14. Rural Poverty Reduction: smaller families, use of farm technology,**

Geographic Spillovers

- 15. Less Migration to Urban Ghettos: more assimilation in provinces**
- 16. More Emigration of Workers after College (a negative externality)**

Although there must be controls for determinants other than education when estimating education impacts on each of these development goal outcomes, if the effects of education on state variables are eliminated using OLS methods through the use of inappropriate controls, and the dynamic impacts over an extended period also are not simulated using appropriate lags, these externality effects of education are eliminated and most education externalities disappear.

Estimates of Education Impacts on Specific Development Goals

Estimates of the *net* impacts of education on specific types of non-market externalities are summarized below in Table 3. They are in excess of the market effects discussed above since they are generated as individuals use their human capital during non-labor-market hours at home and in the community. They are also estimated after controlling for the labor market hours as represented by per capita income.

The estimates represent the net education impacts after 40 years that result from an increase of two percent of income per capita invested in education. About half of this investment cost is in the form of increased foregone earnings by parents as their children stay in school longer. There are lags of 10, 15, or 20 years in gross enrollments representing gross investment in education in each equation. These lags are because it takes time for these children to graduate, and still more time before they have an impact on their communities. Also in empirical tests of the logic of these lags, it takes about that amount of time before the initial effects are detectable nationwide.

The methods can be briefly explained. First, education's *net* marginal product as it relates to each outcome is estimated (i.e., the direct effects) normally based on cross-country data for 78 countries worldwide. In the case of each development outcome there is a control for per capita income or its proxy to remove the indirect market effects of education. There are also controls for all other variables that logically can be expected to influence that outcome are statistically significant with $t > 2.0$. Usually this consists 2-4 additional control

Table 3
Estimates of Education Impacts on Development Goals
Simulations of Outcomes Over 40 Years; Static Plus Delayed Effects

Development Goal Affected by Education	Percent Change in Outcome After 40 Yrs.	Basis for Estimate (after a 2% per capita GDP increase in education investment)	Source
1. Better Public Health	Positive but public vs private health effect unknown	Micro-regressions only. e.g., AIDS education	Grossman & Kaestner (1997)
2. Lower Pop. Growth	0% in Africa (!), ↓ elsewhere	↓ fertility but ↑ health	Appiah and McMahon (2002: 50-1, 65-7)
3. Democratization	36% ↑ in Democracy (i.e. Freedom House Index up 3.7 on a scale of 8), to 6.6	Note: 2% of per capita GDP or \$13.80 in Africa raises gross enrollment rates by about 20 percentage points	See also <u>Freedom House</u> (1999: 536)
4. Human Rights	4% ↑ in Human Rights, on Freedom House Index		
5. Political Stability	3% ↑ in Political Stability on Country Risk Guide Index	“ “ “	<u>International Country Risk Guide</u> (1995)
6. Lower Crime Rates	2% ↓ Homicide Rate 9% ↓ Property Crime	Effect from <i>secondary</i> enrollment rate after controlling for income	Appiah and McMahon (2002: 51-2)
	2% rate of return	Less incarceration costs	Lochner (1999)
7. Deforestation	0.3% ↓ Deforestation	These occur as indirect effects of education reduce poverty & population growth, increase economic growth, and increase democratization.	Appiah & McMahon (2002: 41, 52)
8. Water Pollution	13% ↓ Water Pollution		McMahon (2002: 216, 234-5)
9. Air Pollution	14% ↑ in Air Pollution		
10. Poverty Reduction	18% ↓ in Poverty, 40 Yrs.	Not a pure externality; partially private benefit	Appiah & McMahon (2002)
11. Reduced Inequality	8% reduction in GINI depends on who gets Educ.	Literacy and Equivalency Programs Help the Poor.	Psacharopoulos (1977)

variables in each equation, although many additional variables that might logically be expected to affect each outcome were tested and found not to be significant and will not be discussed here (see however McMahon, 2002; Chs. 6-13, and Appiah and McMahon, 2002: 64-8). The estimates of each equation have a probabilistic error margin and should not be regarded as precise point estimates; there is also always an unexplained residual. The

difference equation system that results (one equation for each outcome) is a more fully specified system of the type discussed in Eqs. (1-3) above, and is used for simulations of the outcomes. It generates a time path for each outcome as the lags are fed and new levels for each development goal are repeatedly generated. Some of these endogenous development goals also interact with other development goals, normally after a lag, so that the system is basically recursive, minimizing estimation problems with simultaneity.

Most theoretical solutions can be interpreted as running out to where time approaches infinity. But since it is possible that the parameters eventually change (although in most cases this seems rather unlikely since it is slow long run processes that are the focus), the simulations were run for only 40 years, long enough to see if they begin to converge. It must be emphasized strongly that the purpose of such simulations is not forecasting , but instead to isolate the net effects of one particular policy change under predefined conditions. Also with respect to the choice of 40 years, the simulations estimate outcomes for shorter periods and one could look at and discuss the smaller net impacts for these shorter periods if desired. The initial conditions for the simulations for each country, or for the all-Africa average which is what is shown in Table 3, are the actual data for that country or that average. They are the initial values of all of the development measures inherited by each country from its past. In this way each new generation inherits an improved platform from which to start, not only in family income but also in the non-market aspects development.

Discussion of Education Impacts on Each Development Goal

The education impacts on each development goal are estimated by subtracting the “no policy change” time path from the “education policy change” time path. They will be discussed and compared briefly to other estimates found in the literature.

1. Public Health Externalities. Grossman and Kaestner's (1997) survey identifies some public health effects. More comprehensive simulations are not possible for this outcome. But education improves private and hence public health, and can reduce the spread of AIDS.

2. Lower Population Growth. Lower population growth rates are a social benefit because they reduce human capital and physical capital dilution from population growth pressures. Fewer children also reduces the total costs of primary education, permitting improvement in quality. All of these contribute to faster per capita growth and development. But theoretically, and in the underlying structural equations that are estimated, there are three structural effects that interact:

- Primary and secondary enrollment of females (both lagged 20 years) improves health and lowers infant mortality, while this in turn and also secondary enrollment of females significantly increases longevity in cross country data. Controls include per capita income, and Africa/Asia dummies which are proxies for per capita income. But these effects on better health increase net population growth as illustrated in Figure 2.
- However increased female education at primary plus secondary levels (lagged 20 years) also lowers fertility rates. If this is interacted with family planning efforts, the effect is strengthened and the t statistic reaches 9.80 with similar controls. This fertility rate effect operates to lower population growth as is also illustrated in Figure 2.
- The third effect is the combined net effect of these two structural forces on net population growth, the non-linear green line in Figure 2. The latter is a definitional identity. As females attain about 9 years of education on average, the fertility effects begin to swamp the health effects on population growth, and rates begin to fall.

Empirically, the poorest countries are to the left in Figure 2 and have high net population growth rates as shown by the black triangle for the Sub-Saharan Africa average. There a high percentage of females have not yet completed primary school, and when investment in education involving females is increased, net population growth rates rise. This is because if females have less than about 9 years of education, the dominant effect is to lower infant mortality, increase longevity, and improve health, all of which increase net population growth rates. The green line in Figure for suggests that until secondary enrollment rates for

females in “Sub-Saharan Africa” reach about 30 percent, net population growth rates can be expected to continue increase, and then level off. In the simulations this in fact happens, and a 0% effect of increased female education on net population growth in Africa is shown in Table 3 even after 40 years. This should not discourage efforts to increase female enrollments in the poorest countries however. The short run effects on health are positive. It is only necessary to

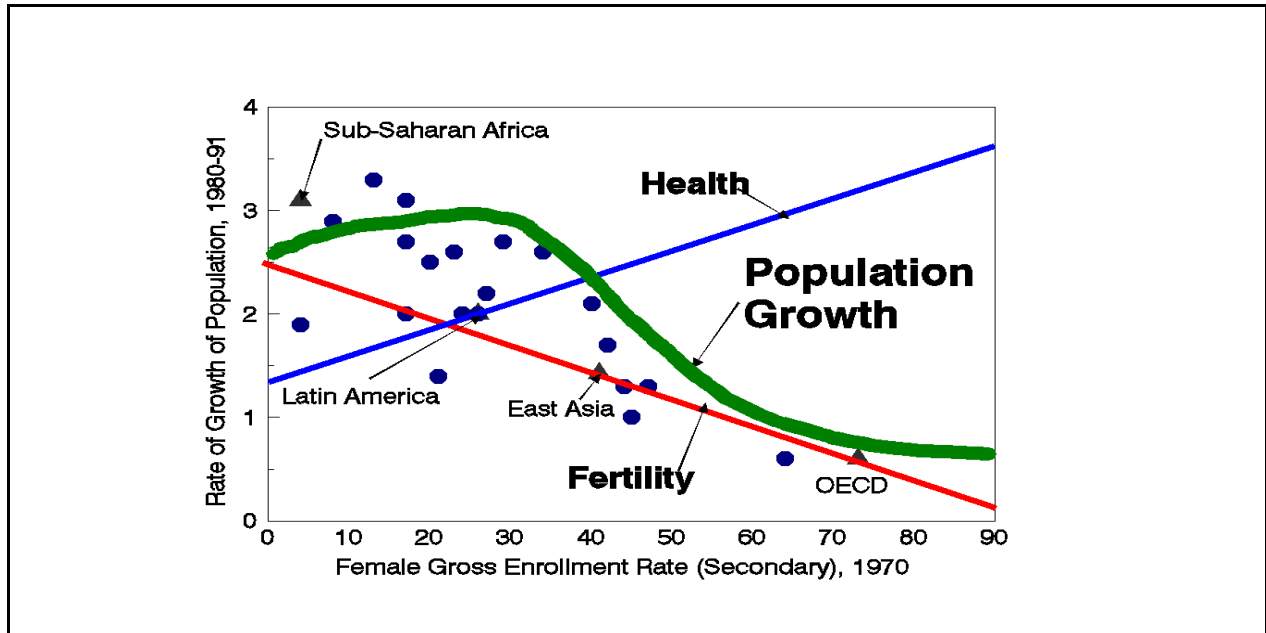


Figure 2 Education and Net Population Growth

use a longer planning horizon because of the huge initial deficits in female education levels.

In the middle income countries, as suggested by the black triangles representing the averages for Latin American and East Asian countries in Figure 2, females generally already have nearly 9 years of education. (Not in individual countries like Bolivia, Honduras, and Hatai however.) In these middle income countries after a lag of 20 years, the larger effect in lowering female fertility dominates and net population growth rates begin to fall. For the OECD average, female secondary education gross enrollment rates average 75% as shown, with almost all females completing 9th grade, and net population growth rates have fallen and continue to fall.

There is a great deal of research based on microeconomic data in a wide range of countries on the effects of additional education in improving infant mortality, own health, the spouse's health, child health, and longevity, as well as on reducing fertility rates. Good surveys by Grossman and Kaestner (1997) and Wolfe and Haveman (1984, 2001) are available that control for family income to avoid double counting the market effects of education and these need not be repeated here. Grossman and Kaestner estimate these health effects alone to be a sizable 40% of the value of the market returns to education.

3. Democratization. "Democratization" is used here as shorthand to reflect the building of civic institutions, development of the rule of law, protection of the role of opposition parties and candidates in the electoral process, lack of domination by the military, and the other items as measured for all countries by the Freedom House (1999) index. These all require a literate population since authoritarian dictatorial regimes find a more hospitable climate where poverty and illiteracy are widespread.

The rationale for the role of both education and growth of per capita income in democratization is best drawn primarily from political science. It is that rising per capita income, associated with a growing middle class, gives rise to demands for participation in the political process that increasingly cannot be ignored by authoritarian regimes (Diamond, 1992; Huber, Rueshmeyer, and Stephens (1993). A widespread middle class requires a literate population, and probably at least some secondary education.

Empirically, as can be seen in Figure 3, with the black triangle showing the average for Sub Saharan Africa, essentially all countries in the world with per capita incomes below about \$600 (not all of which can be shown) are authoritarian. The one exception is India.

There a

very influential individual, Pandit Nehru, believed deeply in democracy. There was also a heritage of English laws, the rule of law, trained civil servants, and viable parliamentary institutions. It is unfortunate that he did not have an equal commitment to basic education as a source of economic growth and development (McMahon 2002:193-99). Perhaps largely as a result primary education there until very recently was viewed only as a family welfare benefit

with contributions to slowing population growth rates and to per capita economic growth that remained unrecognized. It is not surprising that population growth rates remained high, and that real per capita income 50 years after independence was no higher than at the time of independence. Female illiteracy in rural areas and net population growth rates are still high. There have been some improvements in very recent years with shifts of education investment from higher education to basic education and with some per capita growth. Pakistan is more typical of the worldwide pattern. There a civil war resulting in the separation of Pakistan from India was led by Muslims who did not share Nehru's beliefs in democracy. This resulted in a

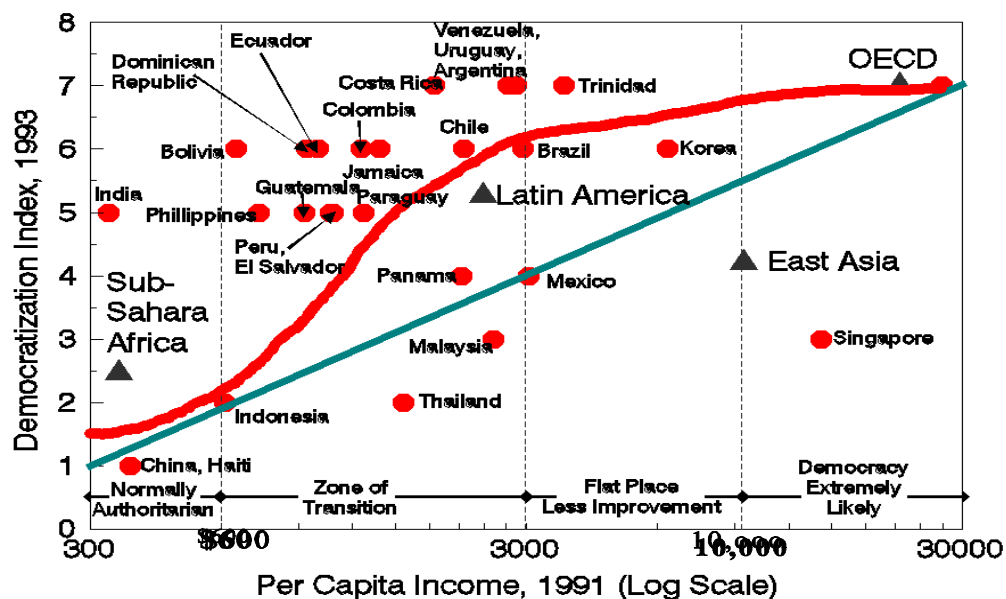


Figure 3. Per Capita Income, Education, and Democratization

military dictatorship that persists, as does extensive illiteracy of females in the rural areas.

The determinants of democratization which are significant by standard t-tests are found to be investment in secondary education (as measured by secondary gross enrollment rates lagged 15 years), per capita income growth (lagged 5 years), and military expenditure as a percent of government budgets (also lagged 5 years). The latter has a negative relation to democratization. Other potential explanatory variables were not found to be significant in the cross country data, such as urbanization, and newspaper/TV access. However Clague et. al

(1996) tried a dummy variable for British heritage and found it significant. A dummy variable for Islam religion remains negative but is insignificant when the other variables mentioned are included. The adjusted R^2 is .49 which is not high, but also not bad for cross section data. An unexplained variation remains to be explained however. An alternative specifications containing secondary educational attainment instead of enrollment rates with lower t statistics and a lower adjusted R^2 is shown and discussed in McMahon, 2002, pp. 98-101). In Figure 3, if the effect of rising income is represented by the straight line, the lagged effects of higher secondary education enrollment and investment rates can be thought of as represented schematically as the space above this to the red line. Although three effects are not well represented in a two dimensional diagram, the association of both education investments and higher per capita income with improving degrees of democratization is apparent.

In the case of military expenditure as a percent of the government's budget, it is possible that there is some reverse causal flow, with democracies spending less on the military and more on education because they are democracies. But although there probably is two-way causation, the lags and the preponderance of the political science literature reviewed by Diamond (1992) both suggest that the main direction of causation is from rising per capita income, and increasing education, to democratization. Some regimes hang on longer with large military expenditure (North Korea? Mjumdar?). But the eventual change over to fragile democracies from military dictatorships has been remarkable in the last 40 years in Latin America for example. It is also noteworthy that all 28 current OECD members have relatively high education levels and also are democratic by Freedom House's (1999) measure. This is shown by the OECD average (black triangle) in Figure 3. Huber, Rueschemeyer and Stephens (1993) further document this process. Barro (1997, 2001) and Clague et al. (1996) also find that when literacy is included as a determinant of democratization, its t-statistic is *very* high.

The net effect on democratization of increased investment in education alone is estimated to be a 36% increase in the democratization index after 40 years as indicated in Table 3 above (Appiah and McMahon 2002: 41).

There are two other aspects of the influence of education on the development of civic institutions on which there is empirical evidence. They are the extent to which those at given income levels with more education contribute more volunteer time and more financial resources to civic organizations. With respect to volunteer hours for community service, a Gallup survey in the United States reveals that within each income group, 22% of those with some post-secondary education give generously of their time to community service activities. This is nearly twice as often as the 12% of those with a high school education (NCES 1995: 98) who give generously. Hodgkinson and Weitzman (1988) found a similar pattern in an earlier nationwide survey. With respect to financial giving to eleemosynary institutions, the evidence is that the college educated give 3% or more of their income to charity about twice as often as high school graduates. This is true in lower income groups where 24.7% of the college educated give generously as compared to 12.5% of the high school graduates. It is also true in higher income groups where 19.1% with college vs. 7.5% with high school educations give generously. This benefits others and is a social benefit externality even though the giver may also gain some private satisfaction. It contributes to the strengthening of eleemosynary institutions, many of which are civic institutions fundamental to democratization. If such surveys were conducted in developing countries with controls for per capita income (there are none to the author's knowledge), it seems reasonable to expect that similar patterns would be found. However ex ante, most students do not weigh the possibilities for community service very highly when making college investment decisions as revealed in a national survey of prospective students in the United States (McMahon 1984). When public leadership is well educated and committed to public service, there can be external social benefits for many generations to come (Bowen 1977, Thomas Jefferson 1787).

4. Human Rights. Human rights is defined here to be civil rights as it normally is by political scientists in the west and by Freedom House (1999). Other definitions sometimes include education and health. But these are treated here as important but separate development outcomes as distinguished from human rights. Human rights includes freedom of the press, radio, and TV, freedom of assembly, an independent judiciary, no imprisonment for political

crimes, gender equity, avoidance of use of torture, and absence of serious corruption. As with democracy, human rights can be regarded as a public good, largely free to all.

The rationale for the relation of education to the spread of human rights is similar to that for democratization above. Empirically human rights are determined by growth of per capita income (lagged 5 years), secondary education investment (as measured by enrollment rates lagged 10 years), and the degree of democratization, itself a function of education. Again there is a negative and highly significant relationship to military expenditure as a percent of

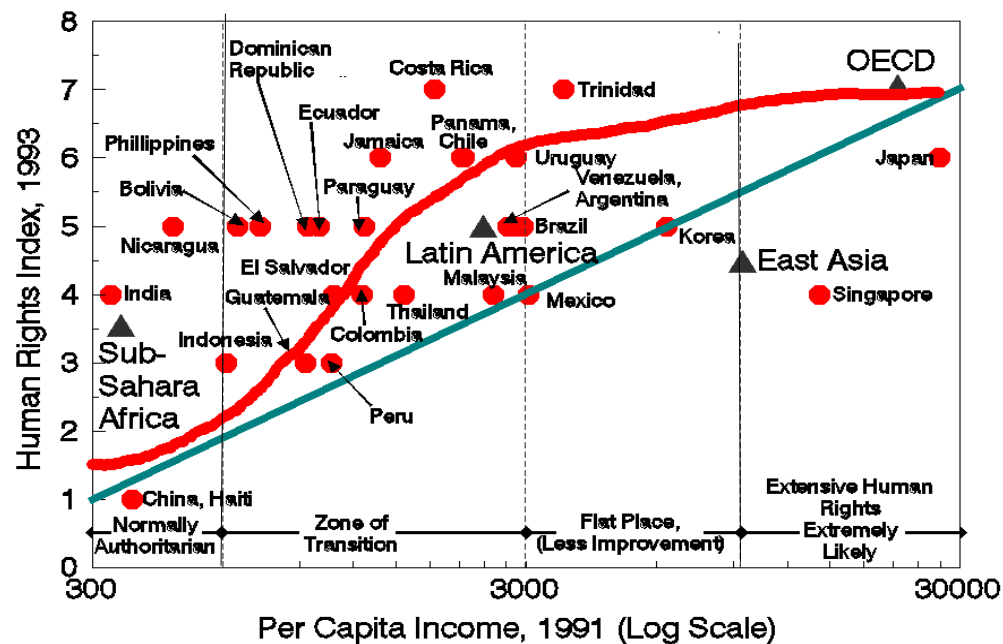


Figure 4. Per Capita Income, Education, and Human Rights

government budgets (lagged 5 years). The adjusted R^2 is again reasonably high (.87). The unexplained variation remaining to be explained is somewhat smaller than for democratization for obvious reasons. Other variables were not found to be significant. Variations in this specification and other controls tested are discussed in McMahon (2002, pp. 102-4).

Human rights increase by 8% in Africa on the average 40 years after education investment is increased by 2% of GDP. This is as shown line 4 of Table 3. They even increase by 33% in the poorest most war-torn countries in Africa! (Appiah and McMahon 2002: 51).

It is another matter to suggest that democracy and human rights contribute to growth directly. This is much debated (e.g., deHaan and Siermann 1995). Barro (1991, 1997) concludes that democratization does not contribute significantly to growth directly. Instead the weight of the evidence suggests that democratization and human rights contribute to political stability, and this in turn to investment in physical capital and to growth (Appiah and McMahon 2002: 41; Barro and Sala-I-Martin 1995: 451; Diamond 1992). Oliva and Rivera-Batiz (2002) find indirect effects as democratization and stability encourage Foreign Direct Investment which then contributes to growth. So their result is consistent with the conclusion here.

5. Political Stability. Political stability as measured by the International Country Risk Guide (1995) increases with democratization. The theory leading to hypotheses to be tested concerning the determinants of persistence of political stability again must draw to some extent from political science. As with democratization and human rights, rising income, higher levels of education, and democratic participation are clearly conducive to greater political stability. As can be seen in Figure 5, the OECD nations on average (black triangle) which have higher per capita income, widespread education, and democracy are also highly stable.

The relation of military expenditure to political stability is more problematical. Authoritarian regimes can be supported by large military expenditures in the short run at least as suggested earlier. But this may be less sustainable in the long run (e.g. the Soviet Union). In fact in the longer run, excessively high military expenditure may be de-stabilizing. Empirically, the positive determinants of political stability significant at or close to the .05 level are per capita economic growth (lagged 5 years), secondary education enrollments (lagged 20 years), democratization. Military expenditure (lagged 5 years) has a significant

negative relationship. Although political stability is correlated with democratization, there are instances of governments that are somewhat authoritarian and also politically stable (China, Singapore, Saudi Arabia). But this was not the long run experience of Latin American countries that delayed democratization, or even in Europe earlier (e.g. the French revolution).

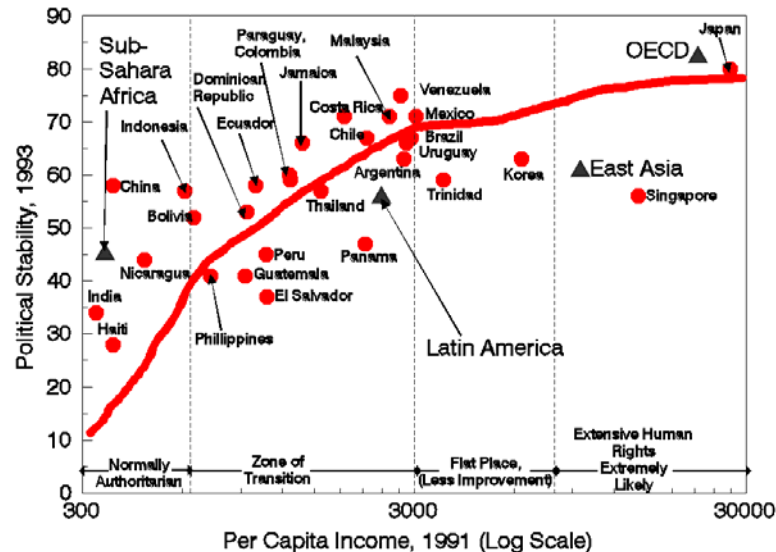


Figure 5. Per Capita Income, Education, and Political Stability

Political stability increases by 3% on average in Africa as primary and secondary education investment increases by 2% of GDP in estimates in Table 3 generated by the simulations. It increases by 7% in the very poorest countries over 40 years. But also democratization increases, human rights improve, and per capita income rises (Appiah and McMahon: 51). As mentioned, Barro (1991, 1997), Barro and Sala-I-Martin (1995: 426), McMahon (2002), and now Oliva and Revera-Batiz (2002) find that democratization contributes to political stability, and all find that political stability in turn contributes to growth.

6. Lower Crime Rates. In an interesting survey of the crime literature, Witte (1997) finds that the average educational attainment of individuals already prone to crime has no relation to their criminal activity. But this survey also indicates that large numbers of

unsupervised teenagers on the streets is very significantly related to crime rates. Additional recent work has been done on this by Lochner and Moretti (2003).

Empirically in cross country data, and consistent with this, larger secondary gross enrollment rates and unemployment rates lagged 2 years are found to be significantly related to lower homicide rates after controlling for per capita income (McMahon, 2002, p. 144, Model 6). ‘Homicide’ is used as an index for violent crime based on the judgment that the data is more accurate in most countries because of larger under-reporting of other types of violent crime such as rape, robbery, and aggravated assault. The relationship to secondary school enrollment rates is illustrated in Figure 6 below. The black triangles represent regional averages for more countries than the scatter of individual countries shown for illustration. There may be an under-reporting problem even for murder in Sub-Saharan Africa.

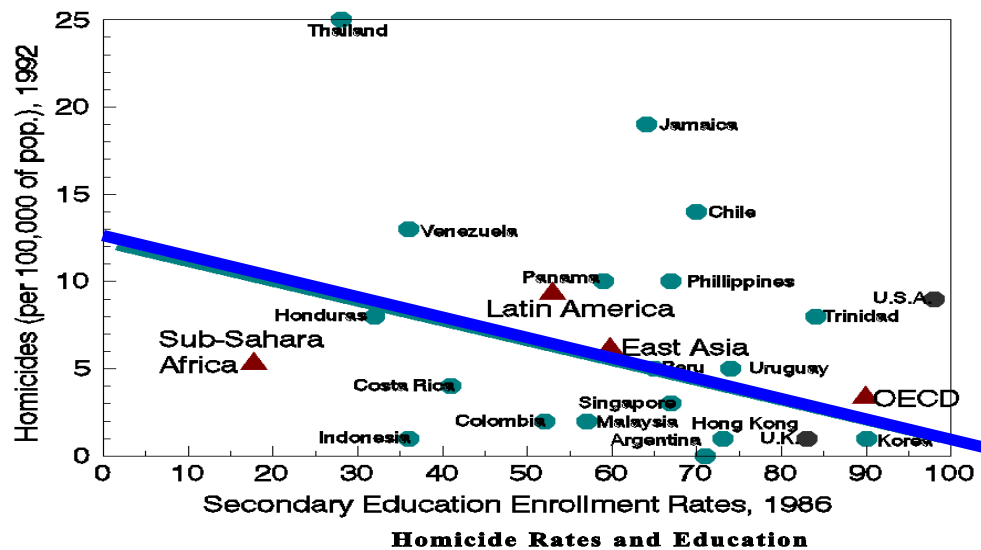


Figure 6. Secondary Enrollment Rates and Homicide

If instead of secondary enrollment rates, poverty is used in the regression instead, the t-statistic is even larger ($t=5.98$) as is the R^2 (.54), (ibid. Model 5). Replacing this with inequality, there is still a positive relation to homicide rates although the t-statistics or R^2 are

as not as high (ibid., Models 2 and 3). Poverty and inequality, however, are both significantly lowered by secondary education investment (as shown below). So the effect of education on crime may be partially indirect as it lowers poverty and inequality.

Homicide rates are 2% lower in Africa 40 years after the increase of 2% of GDP in education investment. The effects are larger, however, in the more progressive higher income countries. This is because the model simulations direct a larger fraction of the education investment to secondary enrollments, since universal primary education has been achieved.

Property crime also as measured by INTERPOL (1998) data is a somewhat different story. Again secondary enrollment significantly lowers lower property crime rates after controlling for per capita income. But now property crime rates are positively and significantly related to *higher* per capita income in all models (McMahon, 2002, p.138). This is seen in Figure 7 by the rise in property crime rates going from lower to higher per capita income countries. Note the black triangles for Sub-Saharan Africa and Asia, moving to higher property

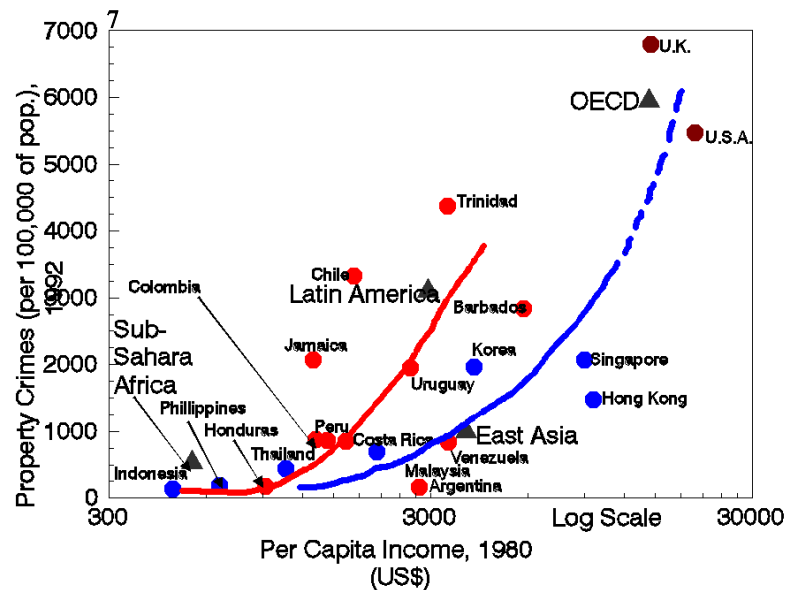


Figure 7. Per Capita Income, Secondary Enrollment Rates, and Property Crime

crime rates in the higher income Latin American and OECD countries. Higher secondary education enrollment rates shift the line downward, from the red to the blue line in Figure 7. The UK has lower homicide rates than the US, but higher property crime rates.

Property crime rates are 9% lower after 40 years in Africa, but only after controlling for per capita income. Without this control, they are 1.2% higher after 40 years, the latter effect due to economic growth, (McMahon 2002: Chapter 10, and Appiah and McMahon 2002).

Conclusions particularly about property crime must be qualified by the fact that there appears to be under-reporting, particularly of property crime in lower income countries. However the same effects emerge in United States data and so although the data is poor, the effects are fairly robust. That is, increased secondary education enrollments that keep young boys off the streets and encourage better peer group relationships lower urban poverty and inequality. These as well as a lower unemployment rate (lagged 2 years) are all associated with lower homicide rates and lower property crime rates. However property crime rates rise with per capita income. This latter is a negative externality and includes white collar crime. This partially offsets the positive benefits from increased investment in education. See also earlier work by Spiegleman (1968) and Ehrlich (1975).

But beyond this, better education reduces the costs of building prisons, of incarceration, and the costs to victims. This is estimated by Lochner (1999) to be 20% of the private monetary return, or a 2% social rate of return, as shown in Table 3 above. It is an additional add-on externality. Research on productivity in schools that limits school “productivity” to increases in academic test scores (e.g., Hanushek 1994: 1997) overlooks these important externalities as larger secondary enrollment rates lower murder and property crime rates and costs of the criminal justice system. These are also likely to be non-market benefits of primary school equivalency, secondary school equivalency, and literacy programs. Most of the prisoners in US prisons are functionally illiterate, and California predicts its need for building additional prison cells based on the 5th grade completion rate.

7. Deforestation. The logic behind this education's *indirect* effects on the environment is that forests are cleared for agriculture as population grows (e.g. Brazil), and for heating and cooking where poverty rates are high (e.g. Nepal, or historically in Britain). Forests are also cut for raw material exports such as is occurring rapidly in Indonesia and Thailand. Deforestation in turn is the source of most destruction of wildlife mammals. These problems continue at a rapid pace.

Empirically, high population growth and high poverty rates are related to higher rates of destruction of forests. In Figure 8 for example, the countries circled in Latin America where population growth and poverty are highest are also those where the annual rates of destruction of forests and wildlife is highest.

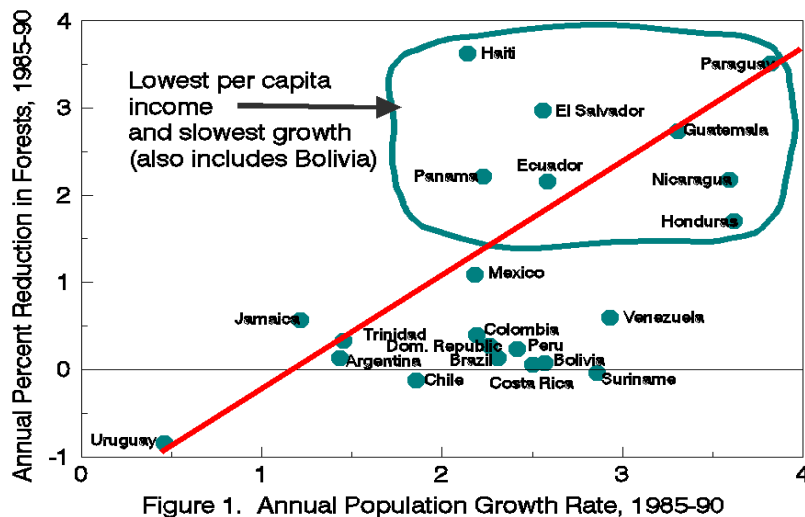


Figure 8. Population Growth and the Destruction of Forests and Wildlife

The effects of education in this case are all indirect, through the reduction of population growth and reduction of poverty. In Latin America after controlling for the initial GDP per capita, population growth and rural poverty are both related with highly significant t-statistics to the destruction of forests, as is the clearing of forests for agriculture. After

correcting for heteroscedasticity (as in all models), the R^2 of .72 and .76 in Models 1 and 2 are fairly high (McMahon, 2002, p. 130). Other effects were tested but not found to be significant. In Africa the *indirect effects* of more education through reduction of poverty and reduction of population growth rates are estimated to lead to about a 0.3% percentage point reduction in the rate forests are being destroyed as shown in Table 3 (Appiah and McMahon 2002: 52, 68).

Although additional micro studies also exist of the relation of population growth and high poverty to deforestation rates, it is wise to be alert to the possibility of spurious correlation. But when structural equations relating to education impacts on population growth and poverty, and the equation relating these to deforestation, are solved analytically, the net effect on the reduced destruction of forests still is apparent.

8-9. Water and Air Pollution. The effects of more education on water and air pollution are also almost entirely indirect. In the case of water pollution, education again first reduces poverty and population growth rates. Then these two effects after controlling for per capita income are quite robust (McMahon, 2002, p. 134, Models 1 through 6). Almost as an

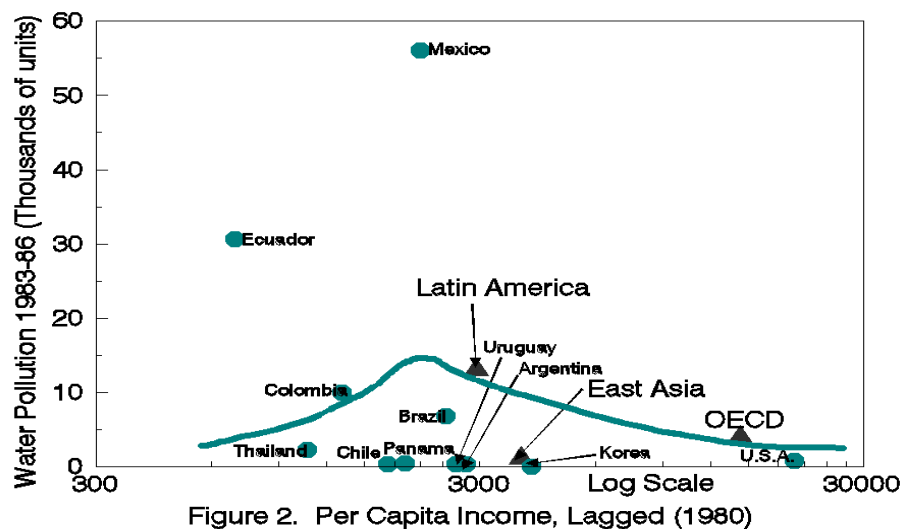


Figure 9. Per Capita Income and Water Pollution

aside, it is interesting that democratization and higher education are under some conditions are significantly associated with reduced water pollution (ibid., Model 1). The $R^2 = .60$ in this model again is fairly good for cross section data.

In Figure 9 the relation of growth in per capita income to falling water pollution can be seen comparing the triangles for Latin American average and OECD average. Africa is not shown because the data is unavailable for almost all countries. East Asian water pollution levels have fallen even more dramatically than the OECD compared to Latin America. A few individual countries suggest the scatter. Although the available data is scarce, water pollution in Mexico appears to be extremely high. Together these indirect effects of education lead to about a 13% reduction in the amount of water pollution in India for which the data is reasonably good (computed from McMahon 2002: 197).

With respect to air pollution, in Africa the same education policy change leads *through similar indirect effects on population growth and democratization* to about a 14% reduction in air pollution. The latter is only after controlling for the adverse growth effects of economic growth on air pollution (computed from Appiah and McMahon 2002, p. 41). If the effects of increased education on economic growth as it increases air pollution are included, then all the indirect effects of education combined (growth + population + poverty + democratization) lead to about a 14% *increase* in air pollution (computed from the equation in Appiah and McMahon 2002, p. 42). Although this is a negative externality, it should also be stressed that some of the indirect effects of education *controlling for growth* operating through democratization, population, and poverty are associated with *reduced* air pollution. The issue of global warming needs to be addressed differently since some countries contribute more in absolute terms than others to this problem. But the tentatively adverse effects of growth on global warming, and the tentatively desirable effects of poverty reduction, slower population growth, and democratization may be suggestive of some directions for further research.

10. Poverty Reduction. Secondary education has a highly significant effect in reducing absolute rural poverty. This is over and above the effects of rising per capita income

on poverty reduction that is illustrated in Figure 10. Increased primary education enrollments also are related to poverty reduction. But although this is important in Africa, the primary education relationship to poverty reduction is less significant in worldwide data, given that most countries already have universal primary education. Secondary gross enrollment rates (lagged 20 years) are even more significant worldwide than rising per capita income. This impact of secondary education is the largest when there is a control for larger military expenditure, since the latter appears to contribute to rural poverty (McMahon, 2002, p. 115).

Absolute Rural Poverty

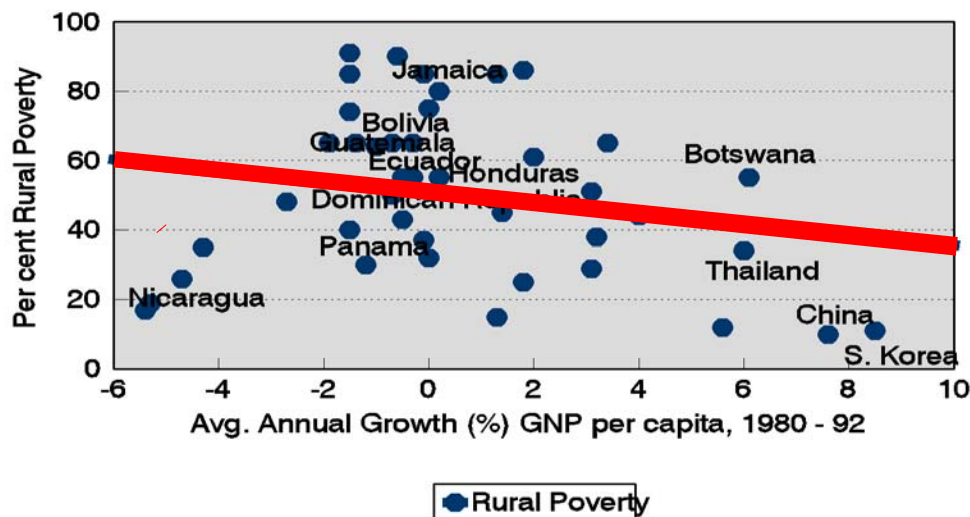


Figure 10. Faster Growth Associated with Falling Rural Poverty

To estimate the approximate size of this impact, rural poverty is reduced by about 18% within 40 years after education investments are increased by 2% of GDP in Africa (Table 3).

It is likely that there is also some reduction in poverty rates in urban areas where per capita income and education investment increase. This is not shown here because the regression coefficients in cross country data are less significant. Garfinkle and Haveman

(1977, p. 53), however, find a strong negative relation between the education of the head of the household and poverty status, with its associated welfare and medical costs.

11. Inequality. The rationale for the relation of education to inequality is that if education is made available to the poor, then they have better earning capacities and capacities to understand and use new technologies. This means that the income distribution effects of education depend primarily on *who gets the education*, a fact that has been demonstrated empirically (Psacharopoulos, 1977). There are also many recent studies of education, income inequality, and growth (e.g. Teulings and Van Rens, 2003). This is not to suggest that the wider distribution of basic education is the only factor that determines inequality. There are others such as agricultural, exchange rate, and tax policies. In the 1990's and 2000's, rapid technical change and globalization have increasingly placed those with only a primary or a high school education at a disadvantage. Tax policies in the US and UK have also contributed to rising inequality (see Figure 11, arrow on the far right). But over the long run and worldwide, the extension of education for all does lay the basis for a wider distribution of earnings, a larger middle class, an increased importance of income from human capital in relation to income from property, and hence for falling inequality.

Empirically, this difference in education policies in cross country data is illustrated in Figure 11. For those countries that merely increase the average amount of education, and do not place emphasis on attaining universal primary and universal secondary education first, the path is illustrated by the Kuznets inverted U curve shown as a curved (blue) line. Brazil is at the top with very high inequality as measured by the GINI coefficient, but also relatively high per capita income. However in Brazil secondary and even primary education has not been equitably distributed to the poor especially in the rural areas, although there may be some

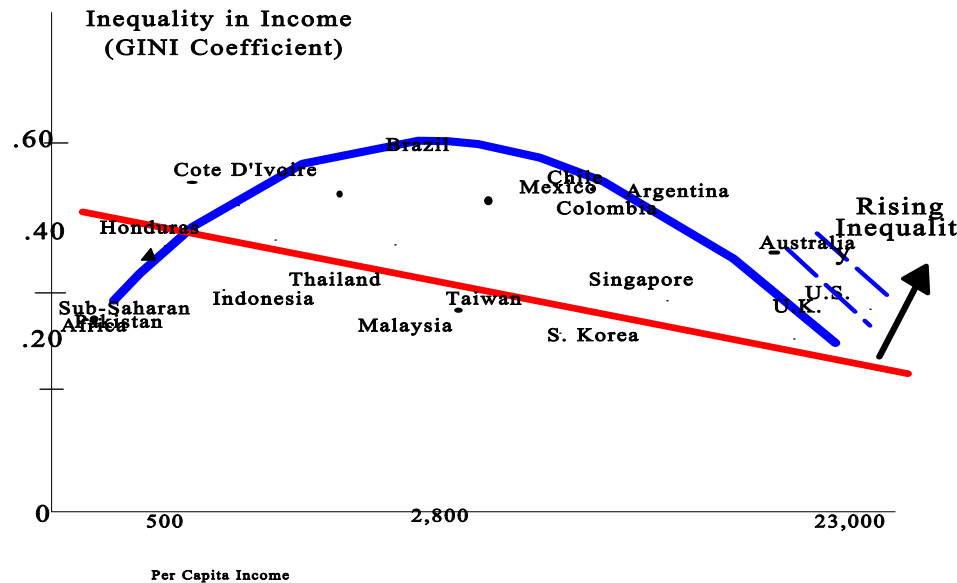


Figure 11. Per Capita Income and Inequality: Curved and Straight Lines Represent Differences in the Distribution of Education

improvements recently. Harbison and Hanushek (1992, pp. 192-199) and Ehrlich (1975) also find a strong relation between inequalities in schooling and the relative number in poverty at the lower end of the income distribution. However where education at the primary and secondary level was rapidly made universal, as in East Asia starting with Japan, and including Singapore, South Korea, Taiwan, Malaysia, and now increasingly Thailand and Indonesia, inequality has fallen steadily as economic growth proceeds. The experience of these countries is shown by the straight (red) line. This has been referred to as “growth with equity” by the World Bank (1993).

In the simulations, following changed education policies where the lack of universal basic education receives the greatest emphasis first, inequality as measured by the GINI coefficient is reduced by 8% by increased secondary enrollments in Africa. This is as shown in Table 3 above. The control variables used are economic growth and population growth. A similar effect from education on reduced inequality is found to be “robust to the inclusion of various (additional) control variables” by Sylwester (2002, p. 43).

Summing Up; Total Education Impacts on Development Outcomes

Overall, there remain many questions about education's contributions to specific development outcomes, as well as about their total value. Not all of these have been addressed in the discussion of each equation above, or in the discussion earlier of data properties, the interpretation of variables used to control for simultaneity, and other measurement issues. But it is important that it be clear that each equation discussed above has included controls for all of the effects on each development outcome that can be found to be significant by the t-test. Also all equations with the exception of investment in physical capital (where two stage least squares tests for simultaneous bias were made) are recursive, containing lags that often are quite long. Alternative specifications are also estimated (see McMahon, 2002). Choices among these made for the model simulations are based on choosing specifications where the logic of the process and lags are a logical basis for inferring causation. So they normally are not just correlations that otherwise may be spurious. The choice of which equations to use are those that also have the highest adjusted R^2 and contain variables for which the t-tests are well above the usual .05 standards for significance in almost all cases.¹

With these qualifications, the value of education's impacts on development outcomes, which are externalities, is estimated to be slightly above 37% to 45% of the total investment in education *on average* depending on the region. This may be somewhat overestimated due to smaller amounts of simultaneous bias that have not been fully removed by the methods discussed. But it also may be somewhat underestimated due to measurement error that is not fully offset and due to the failure to be able to fully account for differences in the quality of education. Based on efficiency criteria alone, this 37% to 45% (which should not be misinterpreted as a social rate of return!) is a guide to the appropriate public share in the financing of total investment in education, keeping in mind that total investment includes the private investment of forgone earnings by families as enrollment rates increase. Foregone earnings costs alone average a bit over 50% of the total investment costs, and when private investment in tuition and fees is added, current investment ratios are not far from the estimates of externalities obtained. How this 37-45% varies by education level has not been addressed here. It also does not include any public share based on equity considerations.

This estimate of the value of externalities *as a percent of the total returns to education* is higher in the poorer countries. It also is higher when a longer time period is chosen for measuring education impacts. With respect especially to the poorest countries, although externalities are usually thought of as addressing market failure, it should not be concluded that these estimates totally ignore government failure. The 2% of GDP used for the simulations

¹ Infrequently a variable is retained when it is slightly less than the .05 level, but reaches the .10 level, when it is important to retain it as a control (e.g. per capita income for non-market returns) or important to show that it in fact is not very significant. All regressions have been corrected for heteroscedasticity.

reflect the current average inefficiencies within the education system. They also reflect “average” corruption. Both probably lead to under-investment in basic education in many poor countries where dictators prey on the system. If there is underinvestment, it will be reflected in high social rates of return. If it can be arranged by donors that no less than the average

proportion of new investment reaches the classroom, this higher externality spill-over also implies a higher social value of the economic development outcomes.

VII. Conclusions

The main point of this paper is that most education impacts on development goals are both externalities and are long delayed. As graduates move into the labor force, they have acquired human capital skills and capacities to adapt that they will use throughout their entire life cycle over another 50 to 65 years. This is not only time spent in the labor force, but also leisure time hours spent at home and in the community, and hours spent after retirement during which their human capital continues to contribute to non-market development outcomes. But the process does not stop there, — the standard analysis of a single life cycle will miss many education impacts. The children of these graduates are known to be better

educated and healthier. Their grandchildren as well as the grandchildren of others should enjoy development outcomes such as slow improvements in civic institutions, secular improvements in human rights, less poverty, greater political stability contributing to higher rates of investment in physical capital, a cleaner environment, a better education, wider diffusion of new knowledge in all fields, and generally higher productivity. Immigrants to the UK and the US from developing countries know that their earnings are better, and their quality of life is better from the level of these development indicators than it would be for them in their home country. They may not perceive the extent to which this is due to better education in prior generations. Those studies that control for these development goals, and not just for the influences on each from factors other than education, eliminate most education externalities. They therefore sometimes conclude that the evidence for education impacts and education externalities is “inconclusive” (e.g. Venniker 2001, Behrman and Stacey 2001).

The main conclusion of this paper may be unsatisfactory for some who want a precise answer on how large education impacts are. The size of education externalities and hence of education impacts on development goals depends on the length of time chosen over which the dynamic cumulative impacts are measured. Education externalities and related education impacts on development goals are a continuing work in progress.

In fact, estimates of education externalities based on the narrower static interpretation of the neoclassical model find limited and inconclusive evidence of externalities, and sometimes also limited evidence of education’s impacts on economic growth and on particular non-monetary returns. If, however, a dynamic interpretation of the neoclassical model is chosen that includes indirect effects over longer periods of time, then education impacts are not just immediate and narrowly defined to exclude many externalities, but instead they continually set a new stage for future growth and development and operate cumulatively (e.g., Nelson and Phelps (1966), Romer (1990), Lucas (1988), Heckman and Klenow (1997), Topel (1999), and McMahon (2002, 2002b). If this interpretation is chosen, it is tentatively concluded that the evidence for education externalities is substantial and robust.

Appendix. Non-Market *Private* Returns to Education

A brief digression from the focus on education impacts on development goals is necessary to identify and explain the basis for the valuation of non-market *private* returns to education as 80% of the market returns. This becomes the basis for the total value of the education impacts on development outcomes. That is, a little over 37% to 45% of 1.80 times the market returns, depending on the region.

It could be argued that the non-market private returns to education are development goals also, and are part of the total social benefits of education including the private benefits. In this sense they certainly are also development goals, just as much as are the private monetary returns.

Private non-market outcomes of education are identified in Column 1 of Table 4. They are taken here to be those that benefit not only the individual but also his or her family. This includes some intra-family benefits such as better child education and child health. Wolfe and Haveman (2001) treat the latter as externalities. The reason for including them as private benefits, however, is two fold. First they in fact are private benefits enjoyed by the family. This is the decision unit responsible for most of the private financing of education. The family absorbs almost all of the foregone earnings investment-costs of basic and also undergraduate higher education, plus some of the direct costs through tuition and fees. So for relevance to financing policy and who should pay, as between private and public sources, the fact that the family benefits privately from these non-market contributions of education to better child health, spousal health, and child education and should be willing to pay for them means that they are not externalities.

As above, to avoid overlap between monetary returns and non-market (private) returns, only studies that control for per capita income are considered. This prevents double counting the monetary returns to education. Overlap with monetary returns is also avoided by not listing the substantial impacts of education on labor force participation rates, secularly lower unemployment rates, and earnings from part time employment after retirement. These

are conceptually and empirically normally included in the monetary outcomes of education.

Similarly, to avoid overlap between these non-market *private* benefits and social development outcomes, the lists of each are compared and duplication eliminated. This results in removal of the costs of prison and criminal justice systems and the value of volunteer hours contributed to the community from the lists appearing in Haveman and Wolfe (1984), Wolfe and Zuvekas (1997), and Wolfe and Haveman (2001). Also the benefits from lower fertility rates are hard to split between private benefits to the family and the social benefits included in *per capita* growth. So to split these, better child quality is treated as a private benefit, and reduced poverty as a social development outcome. Few major overlaps remain.

To note briefly what this list of private non-market benefits deliberately does not include, it does not include any benefits from shifts in personal tastes attributable to more

Table 4
Estimate of the Value of Non-Market *Private* Returns*

Private Non-Market Effect of Further Education (1)	Value as A Percent Of Market Returns (2)	Size or Value of Impacts From One Additional Year Of Education (3)	Source of Estimate, or of Coefficients (4)
Better Individual & Family Health	40%	132 studies surveyed	Grossman and Kaestner (1997)
Own Health & Longevity		.07 (Sec. Enrollment)	Appiah & McMahon (2002: 41)
Child Health, ↓ Infant Mortality		.03 (Female Sec. Enrol.)	Appiah & McMahon (2002: 41)
Better Spousal Health		Wife's Educ. ↑ male health	Grossman (1975)
Cognitive Development of Children	11.2%	Mean of 4 studies cited: Value of Parents Ed input	Wolfe & Haveman (2001: 244)
Fertility, Family Size, & Poverty Reduction (private benefits only)	6 %	Mean, 3 studies reviewed -.2(ΔGER1) -.49(ΔGER2)	Wolfe & Haveman (2001: 240) McMahon (1998, 2002)
Consumption Efficiency	1.3%	\$290 in family income	Wolfe & Haveman (2001: 244)
Higher Return on Financial Assets	2 %	Higher return on equities vs savings accounts	Solomon (1975)
Reduced obsolescence of HC via	5 %	The N-M parallel of educ	Nelson and Phelps (1966),

New Leisure-time learning		effect via uses of R&D	Griliches (2000)
N-M Job Satisfaction	4 %	Better working conditions	Duncan (1976)
Greater Amenities in urban life	2 %	Lower salaries accepted where crime rate low	Chambers (1996: 25)
Pure Consumption Effects (while in school, or learning)	9 %	Enjoyment of HS and college yrs. over work	Lazear (1977), Pascarella and Terenzini (2002: Ch. 12)
Total Value of Pvt. Non-Market Returns as a Percent of Market Returns }	80.5%	The social benefits of reduced costs of criminal justice and increased giving are externalities moved to Table 3.	Wolfe & Haveman's (2001:245) estimated value of 100% of market returns less Lochner's (1999) 20% for reduced crime costs and .5% for giving..

Notes: To convert to the percentage amounts in parentheses shown in Column 2, Wolfe and Haveman's (2001: 245) absolute dollar amounts are expressed as a percent of average earnings in the US. These in turn are taken to be \$22,055 in 1996 dollars as used in their computations. The percentages in lines 6-12 are less precise estimates since they are based on the underlying education coefficients reflecting the marginal product of education in producing the outcome in question relative to the per capita income coefficient (i.e. the alternative means) for producing that outcome. Studies reported are those that estimate the value of the outcomes, which is necessary to get an overall estimate.

education. For example, shifts in tastes away from stock car racing and bullfights to enjoyment of symphony concerts and public television may result from more education. These taste shifts can be quantified, but they merely displace other tastes and largely cancel out. Any attempt to get an aggregate value of these shifts across individuals involves interpersonal comparison of utilities that economists reject. The costs, and sometimes the benefits, of divorce and benefits of re-marriage also are not included for the same reason, even though the education of females appears to be related to increases in both.

The substantial empirical basis in the research on each type of non-market private return is surveyed elsewhere and is readily available. So it will not be repeated here. See Michael (1982), Haveman and Wolfe (1984), McMahon (1998), Wolfe and Zuvekas (1997), Grossman and Kaestner (1997), and Wolfe and Haveman (2001). Wolfe's co-authored articles also explain their methods of valuation. The sources in Table 4 are limited to those that these reviewers judge to be of good quality and that also seek to place a value on these outcomes.

The estimated value of non-market outcomes from additional education is estimated by the Haveman, Wolfe and Zuvekas sources cited to be about equal to the value of the

monetary returns to education. Their method is to use the cost of producing the same outcomes by alternative means, means that employ market-produced inputs whose costs are known. For example, education's contribution to better health is valued by using the cost of producing an equivalent increment to health by using purchased health care inputs. Subtracting the items which have been included in Table 3 as development outcomes, the total value of the *private* non-market benefits of education is obtained. It is estimated to be about 80% of the value of the monetary returns to education. This large amount is ignored in rate of return studies. Grossman and Kaestner (1997) in their thoughtful survey of the literature estimate the value of the non-market returns to education in improving own health, longevity, child health, infant mortality, and the spouse's health alone at 40% of the value of the monetary returns (Table 4).

The value of other components of the private non-market returns to education are contributions to the cognitive development of children (valued at 11.2% of monetary returns), lower fertility and family size with consequent effects reducing family poverty (6%), reduced obsolescence of human capital (5%), and various non-market job, environmental, and consumption amenities (4% +2% +9%), all as a percent of market returns. Together these do almost double the private monetary rates of return conventionally estimated. More precisely together they add to the 80.5% of the monetary returns shown in Table 4 to get total returns to education realized privately. If these private benefits were more clearly identified and understood, they would contribute an incentive for additional private investment in human capital by families and individuals.

The estimates must be qualified in various ways. First, they are not offered as precise values but instead as first approximations. When additional research by others with this objective becomes available, the precision undoubtedly can be increased. A second qualification is that some studies find smaller non-market effects, and some find larger effects. The studies that find smaller effects usually implicitly use a static interpretation of the neo-classical model which implies including controls that exclude indirect effects and a shorter time frame.

A third qualification is that it is doubtful that families and prospective students are aware in specific terms of what these non-market private returns to education are. Although families and students value better health and the other returns, it is unlikely that they are aware of the extent to which these are specifically connected to their own further education. They also are likely to be myopic in not valuing highly the expected contribution to the health and education of children not yet born. This means that they will discount these future non-market returns heavily, and are likely to under-invest. To get an impression of the size of this discount, a recent survey of college freshmen reports that 73% said making more money or getting a better job were the most important reasons for attending college (Flacks and Thomas 1997). This suggests that only 27% estimated the non-market returns to be at least equally important. When specific types of non-market returns were tested in a nationwide sample of 1,863 entering freshmen, including better education and health of future children, stimulation of lifelong learning, service to society, and finding a spouse with college-developed values, these were found to be of limited significance relative to expected money earnings (McMahon 1984: 87-8). However private discounting of these returns due to poor information does not mean they should be discounted in analyses of optimum social efficiency.

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